

4-Bit Bidirectional Voltage-Level Translator with Automatic Direction Sensing

FEATURES

- No Direction-Control
- Data Rates
100Mbps
- 1.2V to 3.6V on A ports and 1.65V to 5.5V on B Ports ($V_{CCA} \leq V_{CCB}$)
- **V_{CC} Isolation Feature: If Either V_{CC} Input is at GND, Both Ports are in the High-Impedance State**
- Output Enable (OE) Input Circuit Referenced to V_{CCA}
- Low Power Consumption, 10µA Maximum I_{CC}
- No Power-Supply Sequencing Required: Either V_{CCA} or V_{CCB} can be Ramped First
- I_{OFF}: Supports Partial-Power-Down Mode Operation
- Extended Temperature: -40°C to +85°C

APPLICATIONS

- Handset
- Smartphone
- Tablet
- Desktop PC

DESCRIPTION

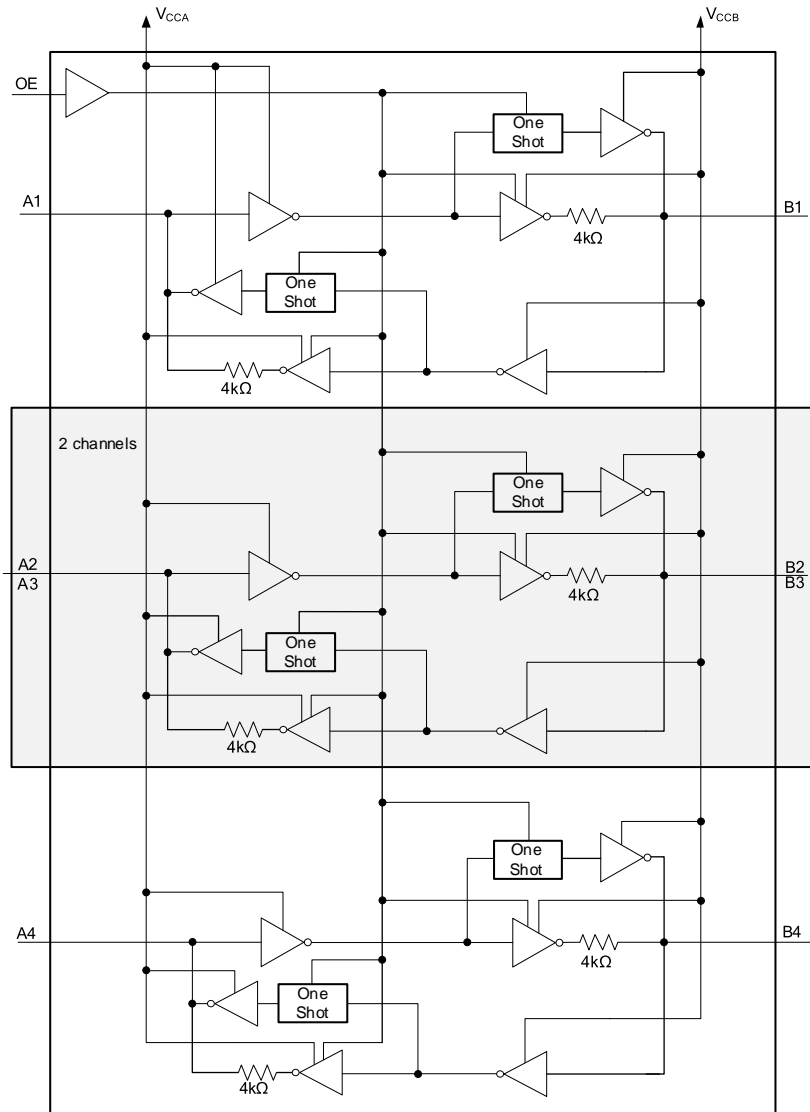
This 4-bit non-inverting translator is a bidirectional voltage-level translator and can be used to establish digital switching compatibility between mixed-voltage systems. It uses two separate configurable power-supply rails, with the A ports supporting operating voltages from 1.2V to 3.6V while it tracks the V_{CCA} supply, and the B ports supporting operating voltages from 1.65V to 5.5V while it tracks the V_{CCB} supply. This allows the support of both lower and higher logic signal levels while providing bidirectional translation capabilities between any of the 1.2V, 1.5V, 1.8V, 2.5V, 3.3V and 5V voltage nodes. V_{CCA} must not exceed V_{CCB}.

When the output-enable (OE) input is low, all outputs are placed in the high-impedance state, which significantly reduces the power-supply quiescent current consumption. OE has an internal pull-down current source, as long as V_{CCA} is powered.

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.

The RS0204 is available in Green QFN3.5x3.5-14L, QFN1.7x2-12L and TSSOP-14 packages. It operates over an ambient temperature range of -40°C to +85°C.

Functional Block Diagram

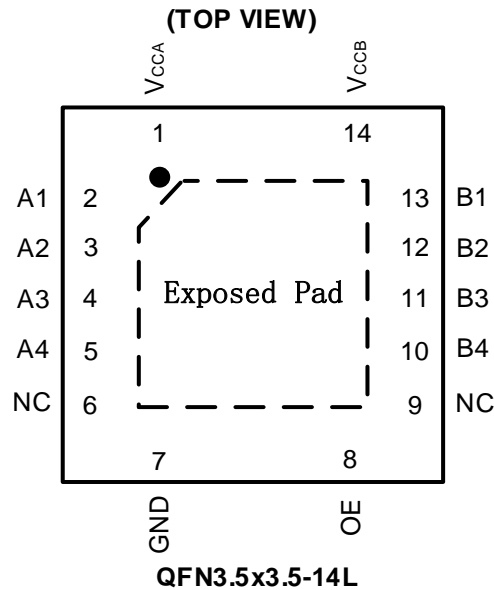


Revision History

Note: Page numbers for previous revisions may differ from page numbers in the current version.

| VERSION | Change Date | Change Item |
|---------|-------------|--|
| A.0 | 2021/1/20 | Preview version completed |
| A.1 | 2021/4/27 | Initial version completed |
| A.2 | 2021/5/27 | Added TAPE AND REEL INFORMATION |
| A.3 | 2021/10/12 | 1. Change QFN3.5x3.5-14L PACKAGE OPTION @Page 9 2. Added Detailed Description and Application Information |

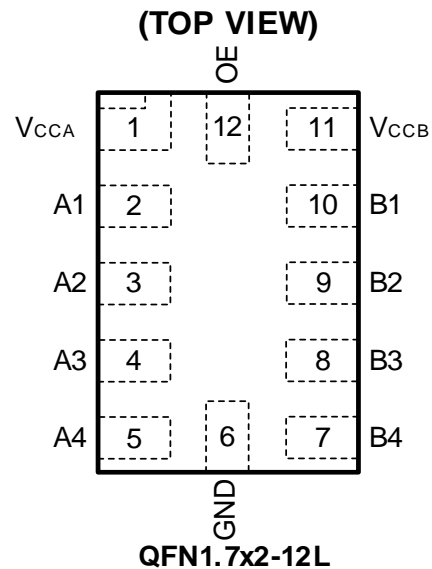
PIN CONFIGURATIONS



PIN DESCRIPTION

| PIN | NAME | TYPE ⁽¹⁾ | FUNCTION |
|----------------|------------------|---------------------|---|
| QFN3.5x3.5-14L | | | |
| 1 | V _{CCA} | P | A Port Supply Voltage. $1.2V \leq V_{CCA} \leq 3.6V$ and $V_{CCA} \leq V_{CCB}$. |
| 2 | A1 | I/O | Input/output A1. Reference to V _{CCA} . |
| 3 | A2 | I/O | Input/output A2. Reference to V _{CCA} . |
| 4 | A3 | I/O | Input/output A3. Reference to V _{CCA} . |
| 5 | A4 | I/O | Input/output A4. Reference to V _{CCA} . |
| 6 | NC | – | No internal connection. |
| 7 | GND | – | Ground. |
| 8 | OE | I | Output Enable (Active High). Pull OE low to place all outputs in 3-state mode. Referenced to V _{CCA} . |
| 9 | NC | – | No internal connection. |
| 10 | B4 | I/O | Input/output B4. Reference to V _{CCB} . |
| 11 | B3 | I/O | Input/output B3. Reference to V _{CCB} . |
| 12 | B2 | I/O | Input/output B2. Reference to V _{CCB} . |
| 13 | B1 | I/O | Input/output B1. Reference to V _{CCB} . |
| 14 | V _{CCB} | P | B Ports Supply Voltage. $1.65V \leq V_{CCB} \leq 5.5V$. |
| – | Exposed Pad | – | Exposed pad should be soldered to PCB board and connected to GND or left floating. |

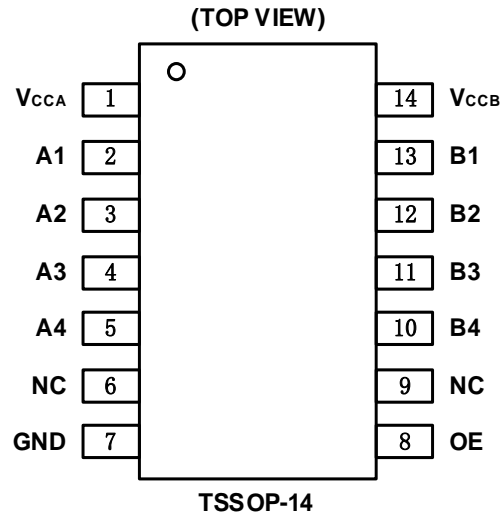
PIN CONFIGURATIONS



PIN DESCRIPTION

| PIN | NAME | TYPE ⁽¹⁾ | FUNCTION |
|--------------|------------------|---------------------|---|
| QFN1.7x2-12L | | | |
| 1 | V _{CCA} | P | A Port Supply Voltage. $1.2V \leq V_{CCA} \leq 3.6V$ and $V_{CCA} \leq V_{CCB}$. |
| 2 | A1 | I/O | Input/output A1. Reference to V _{CCA} . |
| 3 | A2 | I/O | Input/output A2. Reference to V _{CCA} . |
| 4 | A3 | I/O | Input/output A3. Reference to V _{CCA} . |
| 5 | A4 | I/O | Input/output A4. Reference to V _{CCA} . |
| 6 | GND | – | Ground. |
| 7 | B4 | I/O | Input/output B4. Reference to V _{CCB} . |
| 8 | B3 | I/O | Input/output B3. Reference to V _{CCB} . |
| 9 | B2 | I/O | Input/output B2. Reference to V _{CCB} . |
| 10 | B1 | I/O | Input/output B1. Reference to V _{CCB} . |
| 11 | V _{CCB} | P | B Ports Supply Voltage. $1.65V \leq V_{CCB} \leq 5.5V$. |
| 12 | OE | I | Output Enable (Active High). Pull OE low to place all outputs in 3-state mode. Referenced to V _{CCA} . |

PIN CONFIGURATIONS



PIN DESCRIPTION

| PIN | NAME | TYPE ⁽¹⁾ | FUNCTION |
|----------|------------------|---------------------|---|
| TSSOP-14 | | | |
| 1 | V _{CCA} | P | A Port Supply Voltage. $1.2V \leq V_{CCA} \leq 3.6V$ and $V_{CCA} \leq V_{CCB}$ |
| 2 | A1 | I/O | Input/output A1. Reference to V _{CCA} . |
| 3 | A2 | I/O | Input/output A2. Reference to V _{CCA} . |
| 4 | A3 | I/O | Input/output A3. Reference to V _{CCA} . |
| 5 | A4 | I/O | Input/output A4. Reference to V _{CCA} . |
| 6 | NC | - | No internal connection. |
| 7 | GND | — | Ground. |
| 8 | OE | I | Output Enable (Active High). Pull OE low to place all outputs in 3-state mode. Referenced to V _{CCA} . |
| 9 | NC | - | No internal connection. |
| 10 | B4 | I/O | Input/output B4. Reference to V _{CCB} . |
| 11 | B3 | I/O | Input/output B3. Reference to V _{CCB} . |
| 12 | B2 | I/O | Input/output B2. Reference to V _{CCB} . |
| 13 | B1 | I/O | Input/output B1. Reference to V _{CCB} . |
| 14 | V _{CCB} | P | B Ports Supply Voltage. $1.65V \leq V_{CCB} \leq 5.5V$. |

(1) I=input, O=output, I/O=input and output, P=power

SPECIFICATIONS

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) ⁽¹⁾

| SYMBOL | PARAMETER | MIN | MAX | UNIT | |
|----------------------------------|--|--------|------|-----------------------|---|
| V _{CCA} | Supply Voltage Range | -0.3 | 4.6 | V | |
| V _{CCB} | Supply Voltage Range | -0.3 | 6.5 | V | |
| V _I ⁽²⁾ | Input Voltage Range | A port | -0.3 | 4.6 | V |
| | | B port | -0.3 | 6.5 | |
| | | OE | -0.3 | 4.6 | |
| V _O ⁽²⁾ | Voltage range applied to any output in the high-impedance or power-off state | A port | -0.3 | 4.6 | V |
| | | B port | -0.3 | 6.5 | |
| V _O ⁽²⁾⁽³⁾ | Voltage range applied to any output in the high or low state | A port | -0.3 | V _{CCA} +0.3 | V |
| | | B port | -0.3 | V _{CCB} +0.3 | |
| I _{IK} | Input clamp current | | -50 | mA | |
| I _{OK} | Output clamp current | | -50 | mA | |
| I _O | Continuous output current | | ±50 | mA | |
| | Continuous current through V _{CCA} , V _{CCB} or GND | | ±100 | mA | |
| T _J | Junction Temperature | | 150 | °C | |
| T _{stg} | Storage temperature | -65 | +150 | | |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

(3) The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

ESD Ratings

| | | VALUE | UNIT |
|--------------------|-------------------------|------------------------|-------|
| V _(ESD) | Electrostatic discharge | Human-body model (HBM) | ±5000 |
| | | machine model (MM) | ±300 |

Recommended Operating Conditions

V_{CCI} is the supply voltage associated with the input port. V_{CCO} is the supply voltage associated with the output port. ⁽¹⁾⁽²⁾

| PARAMETER | CONDITIONS | | MIN | TYP | MAX | UNIT |
|--|---------------|---|---|-----|-----------------------------|------|
| Supply voltage | V_{CCA} | | 1.2 | | 3.6 | V |
| | V_{CCB} | | 1.65 | | 5.5 | |
| High-level input voltage (V_{IH}) | A-port inputs | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | $V_{CCI} \times 0.65^{(3)}$ | | V_{CCI} | V |
| | B-port inputs | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | $V_{CCI} \times 0.65$ | | V_{CCI} | |
| | OE input | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | $V_{CCA} \times 0.65$ | | 5.5 | |
| Low-level input voltage (V_{IL}) | A-port inputs | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | 0 | | $V_{CCI} \times 0.35^{(3)}$ | V |
| | B-port inputs | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | 0 | | $V_{CCI} \times 0.35$ | |
| | OE input | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | 0 | | $V_{CCA} \times 0.35$ | |
| Voltage applied to any output in the high-impedance or power-off state (V_O) | A-port | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | 0 | | 3.6 | V |
| | B-port | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | 0 | | 5.5 | |
| Input transition rise or fall rate ($\Delta t/\Delta v$) | A-port inputs | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ $V_{CCB} = 1.65\text{ V to }5.5\text{ V}$ | | | 40 | ns/V |
| | B-port inputs | $V_{CCA} = 1.2\text{ V to }3.6\text{ V}$ | $V_{CCB} = 1.65\text{ V to }3.6\text{ V}$ | | 40 | |
| $V_{CCB} = 4.5\text{ V to }5.5\text{ V}$ | | | | 30 | | |
| T_A Operating free-air temperature | | | -40 | | 85 | °C |

(1) The A and B sides of an unused data I/O pair must be held in the same state, that is, 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.

PACKAGE/ORDERING INFORMATION

| PRODUCT | ORDERING NUMBER | TEMPERATURE RANGE | PACKAGE LEAD | PACKAGE MARKING (1) | MSL (2) | PACKAGE OPTION |
|---------|-----------------|-------------------|----------------|---------------------|---------|--------------------|
| RS0204 | RS0204YTQF14 | -40°C ~+85°C | QFN3.5x3.5-14L | RS0204 | MSL3 | Tape and Reel,5000 |
| | RS0204YUTQH12 | -40°C ~+85°C | QFN1.7x2-12L | 0204 | MSL3 | Tape and Reel,3000 |
| | RS0204YQ | -40°C ~+85°C | TSSOP-14 | RS0204 | MSL3 | Tape and Reel,4000 |

NOTE:

- (1) There may be additional marking, which relates to the lot trace code information(data code and vendor code), the logo or the environmental category on the device.
- (2) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted) ⁽¹⁾ ⁽²⁾ ⁽³⁾

| PARAMETER | CONDITIONS | V _{CCA} | V _{CCB} | TEMP | MIN | TYP | MAX | UNIT | |
|---|--|------------------|------------------|-------|-----------------------|------|-----|------|----|
| V _{OHA} Port A output high voltage | I _{OH} = -20 μA | 1.2V | | +25°C | | 1.1 | | V | |
| | | 1.4V to 3.6V | | Full | V _{CCA} -0.4 | | | | |
| V _{OLA} Port A output low voltage | I _{OL} = 20 μA | 1.2V | | +25°C | | 0.3 | | | |
| | | 1.4V to 3.6V | | Full | | | 0.4 | | |
| V _{OHB} Port B output high voltage | I _{OH} = -20 μA | | 1.65V to 5.5V | Full | V _{CCB} -0.4 | | | | |
| V _{OLB} Port B output low voltage | I _{OL} = 20 μA | | 1.65V to 5.5V | Full | | | 0.4 | | |
| I _I Input leakage current | OE V _I =V _{CCI} or GND | 1.2V to 3.6V | 1.65V to 5.5V | +25°C | | | ±1 | | μA |
| | | | | Full | | | ±2 | | |
| I _{off} Partial power down current | A Ports V _I or V _O =0 to 3.6V | 0V | 0V to 5.5V | +25°C | | | ±1 | μA | |
| | | | | Full | | | ±2 | | |
| | B Ports V _I or V _O =0 to 5.5V | 0V to 3.6V | 0V | +25°C | | | ±1 | μA | |
| | | | | Full | | | ±2 | | |
| I _{oz} High-impedance State output current | A or B port OE=GND | 1.2V to 3.6V | 1.65V to 5.5V | +25°C | | | ±1 | μA | |
| | | | | Full | | | ±2 | | |
| I _{CCA} V _{CCA} supply current | V _I =V _{CCI} or GND I _O = 0 | 1.2V | 1.65V to 5.5V | +25°C | | 0.06 | | μA | |
| | | 1.4V to 3.6V | 1.65V to 5.5V | Full | | | 5 | | |
| | | 3.6V | 0V | Full | | | 2 | | |
| | | 0V | 5.5V | Full | | | -2 | | |
| I _{CCB} V _{CCB} supply current | V _I =V _{CCI} or GND I _O = 0 | 1.2V | 1.65V to 5.5V | +25°C | | 3.4 | | μA | |
| | | 1.4V to 3.6V | 1.65V to 5.5V | Full | | | 5 | | |
| | | 3.6V | 0V | Full | | | -2 | | |
| | | 0V | 5.5V | Full | | | 2 | | |
| I _{CCA} + I _{CCB} Combined supply current | V _I = V _{CCI} or GND I _O = 0 | 1.2V | 1.65V to 5.5V | +25°C | | 3.5 | | μA | |
| | | 1.4V to 3.6V | 1.65V to 5.5V | Full | | | 10 | | |
| I _{CCZA} V _{CCA} supply current | V _I = V _{CCI} or GND I _O = 0, OE=GND | 1.2V | 1.65V to 5.5V | +25°C | | 0.05 | | μA | |
| | | 1.4V to 3.6V | 1.65V to 5.5V | Full | | | 5 | | |
| I _{CCZB} V _{CCB} supply current | V _I = V _{CCI} or GND I _O = 0, OE=GND | 1.2V | 1.65V to 5.5V | +25°C | | 3.3 | | μA | |
| | | 1.4V to 3.6V | 1.65V to 5.5V | Full | | | 5 | | |
| C _i Input capacitance | OE | 1.2V to 3.6V | 1.65V to 5.5V | +25°C | | 4 | | pF | |
| C _{io} Input-to-output internal capacitance | A port | 1.2V to 3.6V | 1.65V to 5.5V | +25°C | | 5 | | pF | |
| | B port | 1.2V to 3.6V | 1.65V to 5.5V | +25°C | | 9 | | | |

(1) V_{CCI} is the V_{CC} associated with the input port.

(2) V_{CCO} is the V_{CC} associated with the output port

(3) V_{CCA} must be less than or equal to V_{CCB}.

Timing Requirements:
 $V_{CCA}=1.2V$
 $T_A=25^{\circ}C$, $V_{CCA}=1.2V$

| | | $V_{CCB}=1.8V$ | $V_{CCB}=2.5V$ | $V_{CCB}=3.3V$ | $V_{CCB}=5V$ | UNIT |
|-------------------------|-------------|----------------|----------------|----------------|--------------|------|
| | | TYP | TYP | TYP | TYP | |
| Data rate | | 20 | 20 | 20 | 20 | Mbps |
| Pulse duration(t_w) | data inputs | 50 | 50 | 50 | 50 | ns |

 $V_{CCA}=1.5V\pm 0.1V$
 $T_A=25^{\circ}C$, $V_{CCA}=1.5V\pm 0.1V$ (unless otherwise noted)

| | | $V_{CCB}=1.8V \pm 0.15V$ | $V_{CCB}=2.5V \pm 0.2V$ | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT |
|-------------------------|-------------|--------------------------|-------------------------|-------------------------|-----------------------|------|
| | | TYP | TYP | TYP | TYP | |
| Data rate | | 40 | 40 | 40 | 40 | Mbps |
| Pulse duration(t_w) | data inputs | 25 | 25 | 25 | 25 | ns |

 $V_{CCA}=1.8V\pm 0.15V$
 $T_A=25^{\circ}C$, $V_{CCA}=1.8V\pm 0.15V$ (unless otherwise noted)

| | | $V_{CCB}=1.8V \pm 0.15V$ | $V_{CCB}=2.5V \pm 0.2V$ | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT |
|-------------------------|-------------|--------------------------|-------------------------|-------------------------|-----------------------|------|
| | | TYP | TYP | TYP | TYP | |
| Data rate | | 50 | 50 | 50 | 50 | Mbps |
| Pulse duration(t_w) | data inputs | 25 | 25 | 25 | 25 | ns |

 $V_{CCA}=2.5V\pm 0.2V$
 $T_A=25^{\circ}C$, $V_{CCA}=2.5V\pm 0.2V$ (unless otherwise noted)

| | | $V_{CCB}=2.5V \pm 0.2V$ | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT |
|-------------------------|-------------|-------------------------|-------------------------|-----------------------|------|
| | | TYP | TYP | TYP | |
| Data rate | | 70 | 80 | 80 | Mbps |
| Pulse duration(t_w) | data inputs | 14 | 12 | 12 | ns |

 $V_{CCA}=3.3V\pm 0.3V$
 $T_A=25^{\circ}C$, $V_{CCA}=3.3V\pm 0.3V$ (unless otherwise noted)

| | | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT |
|-------------------------|-------------|-------------------------|-----------------------|------|
| | | TYP | TYP | |
| Data rate | | 80 | 100 | Mbps |
| Pulse duration(t_w) | data inputs | 12 | 10 | ns |

Switching Characteristics: $V_{CCA}=1.2V$

 $T_A=25^{\circ}C, V_{CCA}=1.2V$

| PARAMETER | CONDITIONS | $V_{CCB}=1.8V$ | $V_{CCB}=2.5V$ | $V_{CCB}=3.3V$ | $V_{CCB}=5V$ | UNIT | |
|-------------------|---|---------------------------|----------------|----------------|--------------|------|------|
| | | TYP | TYP | TYP | TYP | | |
| t_{PHL} | Propagation delay time high-to-low output | A-to-B | 27.8 | 21.9 | 20.3 | 26.5 | ns |
| t_{PLH} | Propagation delay time low-to-high output | A-to-B | 26 | 19.1 | 18.6 | 22.1 | ns |
| t_{PHL} | Propagation delay time high-to-low output | B-to-A | 36.9 | 37.1 | 37.5 | 36.6 | ns |
| t_{PLH} | Propagation delay time low-to-high output | B-to-A | 34.5 | 34.4 | 32.8 | 33.2 | ns |
| t_{en} | Enable time | OE-to-A or B | 378 | 387 | 365 | 348 | ns |
| t_{dis} | Disable time | OE-to-A or B | 19 | 16 | 15 | 16 | ns |
| t_{rA}, t_{fA} | Input rise time | A port rise and fall time | 12.3 | 17.1 | 16.5 | 13.1 | ns |
| t_{rB}, t_{fB} | Input rise time | B port rise and fall time | 6.6 | 6.5 | 7.6 | 5.1 | ns |
| $t_{sk(O)}$ | Skew(time), output | Channel-to-Channel Skew | 2.4 | 1.6 | 1.9 | 7.1 | ns |
| Maximum data rate | | | 20 | 20 | 20 | 20 | Mbps |

Switching Characteristics: $V_{CCA}=1.5V \pm 0.1V$

 over recommended operating free-air temperature range, $V_{CCA}=1.5V \pm 0.1V$ (unless otherwise noted)

| PARAMETER | CONDITIONS | $V_{CCB}=1.8V \pm 0.15V$ | $V_{CCB}=2.5V \pm 0.2V$ | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT | |
|-------------------|---|---------------------------|-------------------------|-------------------------|-----------------------|------|------|
| | | TYP | TYP | TYP | TYP | | |
| t_{PHL} | Propagation delay time high-to-low output | A-to-B | 15.1 | 15.7 | 12.8 | 11.6 | ns |
| t_{PLH} | Propagation delay time low-to-high output | A-to-B | 17.9 | 15.2 | 11.5 | 9.8 | ns |
| t_{PHL} | Propagation delay time high-to-low output | B-to-A | 17.4 | 15.3 | 15.1 | 19.6 | ns |
| t_{PLH} | Propagation delay time low-to-high output | B-to-A | 14.3 | 15.3 | 15.7 | 21 | ns |
| t_{en} | Enable time | OE-to-A or B | 225 | 218 | 215 | 216 | ns |
| t_{dis} | Disable time | OE-to-A or B | 18.4 | 15.7 | 14.2 | 13.7 | ns |
| t_{rA}, t_{fA} | Input rise time | A port rise and fall time | 6.2 | 6.1 | 6.1 | 6.2 | ns |
| t_{rB}, t_{fB} | Input rise time | B port rise and fall time | 6.6 | 4.4 | 3.7 | 3.1 | ns |
| $t_{sk(O)}$ | Skew(time), output | Channel-to-Channel Skew | 2.5 | 2.0 | 1.8 | 1.4 | ns |
| Maximum data rate | | | 40 | 40 | 40 | 40 | Mbps |

Switching Characteristics: $V_{CCA}=1.8V \pm 0.15V$

over recommended operating free-air temperature range, $V_{CCA}=1.8V \pm 0.15V$ (unless otherwise noted)

| PARAMETER | CONDITIONS | $V_{CCB}=1.8V \pm 0.15V$ | $V_{CCB}=2.5V \pm 0.2V$ | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT |
|---|---------------------------|--------------------------|-------------------------|-------------------------|-----------------------|------|
| | | TYP | TYP | TYP | TYP | |
| t_{PHL} Propagation delay time high-to-low output | A-to-B | 13.8 | 9.1 | 6.9 | 7 | ns |
| t_{PLH} Propagation delay time low-to-high output | A-to-B | 16.4 | 9.5 | 7.7 | 6.5 | ns |
| t_{PHL} Propagation delay time high-to-low output | B-to-A | 13.3 | 9.3 | 8.6 | 8.1 | ns |
| t_{PLH} Propagation delay time low-to-high output | B-to-A | 10.2 | 8.3 | 8.6 | 8 | ns |
| t_{en} Enable time | OE-to-A or B | 185 | 178 | 183 | 167 | ns |
| t_{dis} Disable time | OE-to-A or B | 18.3 | 13 | 12.1 | 11.2 | ns |
| t_{rA}, t_{fA} Input rise time | A port rise and fall time | 5.8 | 6.3 | 6.6 | 7.7 | ns |
| t_{rB}, t_{fB} Input rise time | B port rise and fall time | 6.2 | 4.5 | 3.5 | 3.4 | ns |
| $t_{sk(O)}$ Skew(time), output | Channel-to-Channel Skew | 0.8 | 0.7 | 0.7 | 0.6 | ns |
| Maximum data rate | | 50 | 50 | 50 | 50 | Mbps |

Switching Characteristics: $V_{CCA}=2.5V \pm 0.2V$

over recommended operating free-air temperature range, $V_{CCA}=2.5V \pm 0.2V$ (unless otherwise noted)

| PARAMETER | CONDITIONS | $V_{CCB}=2.5V \pm 0.2V$ | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT |
|---|---------------------------|-------------------------|-------------------------|-----------------------|------|
| | | TYP | TYP | TYP | |
| t_{PHL} Propagation delay time high-to-low output | A-to-B | 6.9 | 5.3 | 4 | ns |
| t_{PLH} Propagation delay time low-to-high output | A-to-B | 8.1 | 6.2 | 4.8 | ns |
| t_{PHL} Propagation delay time high-to-low output | B-to-A | 5.5 | 4.6 | 4.2 | ns |
| t_{PLH} Propagation delay time low-to-high output | B-to-A | 1.9 | 4.3 | 4.2 | ns |
| t_{en} Enable time | OE-to-A or B | 157 | 147 | 138 | ns |
| t_{dis} Disable time | OE-to-A or B | 13.1 | 9.7 | 8.7 | ns |
| t_{rA}, t_{fA} Input rise time | A port rise and fall time | 3.5 | 2.9 | 3 | ns |
| t_{rB}, t_{fB} Input rise time | B port rise and fall time | 4 | 2.8 | 2.5 | ns |
| $t_{sk(O)}$ Skew(time), output | Channel-to-Channel Skew | 0.4 | 0.4 | 0.3 | ns |
| Maximum data rate | | 70 | 80 | 80 | Mbps |

Switching Characteristics: $V_{CCA}=3.3V \pm 0.3V$

over recommended operating free-air temperature range, $V_{CCA}=3.3V \pm 0.3V$ (unless otherwise noted)

| PARAMETER | CONDITIONS | $V_{CCB}=3.3V \pm 0.3V$ | $V_{CCB}=5V \pm 0.5V$ | UNIT | |
|-------------------|---|-------------------------|-----------------------|------|------|
| | | TYP | TYP | | |
| t_{PHL} | Propagation delay time high-to-low output | A-to-B | 4.8 | 3.6 | ns |
| t_{PLH} | Propagation delay time low-to-high output | A-to-B | 4.9 | 3.8 | ns |
| t_{PHL} | Propagation delay time high-to-low output | B-to-A | 3.5 | 3.2 | ns |
| t_{PLH} | Propagation delay time low-to-high output | B-to-A | 3.9 | 3.1 | ns |
| t_{en} | Enable time | OE-to-A or B | 134 | 128 | ns |
| t_{dis} | Disable time | OE-to-A or B | 9.8 | 7.7 | ns |
| t_{rA} | Input rise time | A port rise time | 1.9 | 1.9 | ns |
| t_{rB} | Input rise time | B port rise time | 1.8 | 2.3 | ns |
| t_{fA} | Input fall time | A port fall time | 2.9 | 2.6 | ns |
| t_{fB} | Input fall time | B port fall time | 1.8 | 1.6 | ns |
| $t_{sk(O)}$ | Skew(time), output | Channel-to-Channel Skew | 0.4 | 0.3 | ns |
| Maximum data rate | | | 80 | 100 | Mbps |

Operating Characteristics

$T_A=25^\circ C$

| PARAMETER | CONDITIONS | V_{CCA} | | | | | | | UNIT | |
|-----------|--|-------------------------------|------|------|------|------|------|------------|------|----|
| | | 1.2V | 1.2V | 1.5V | 1.8V | 2.5V | 2.5V | 3.3V | | |
| | | V_{CCB} | | | | | | | | |
| | | 5V | 1.8V | 1.8V | 1.8V | 2.5V | 5V | 3.3V to 5V | | |
| | | TYP | TYP | TYP | TYP | TYP | TYP | | | |
| C_{pdA} | Power dissipation capacitance $C_L=0$ $f=10MHz$ $t_r=t_f=1ns$ | A-port input B-port output | 9 | 8 | 7 | 8 | 7 | 8 | 7 | pF |
| | | B-port input A-port output | 12 | 11 | 12 | 11 | 11 | 11 | 11 | |
| C_{pdB} | Power dissipation capacitance OE= V_{CCA} (outputs enabled) | A-port input B-port output | 35 | 26 | 27 | 27 | 27 | 27 | 27 | |
| | | B-port input A-port output | 25 | 18 | 19 | 19 | 18 | 19 | 20 | |
| C_{pdA} | Power dissipation capacitance $C_L=0$ $f=10MHz$ $t_r=t_f=1ns$ | A-port input B-port output | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | pF |
| | | B-port input A-port output | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| C_{pdB} | Power dissipation capacitance OE=GND (outputs enabled) | A-port input B-port output | 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 | |

Parameter Measurement Information

Unless otherwise noted, all input pulses are supplied by generators having the following characteristics:

- PRR 10 MHz
- $Z_o = 50 \Omega$
- $dv/dt \geq 1 \text{ V/ns}$

Note: All input pulses are measured one at a time, with one transition per measurement.

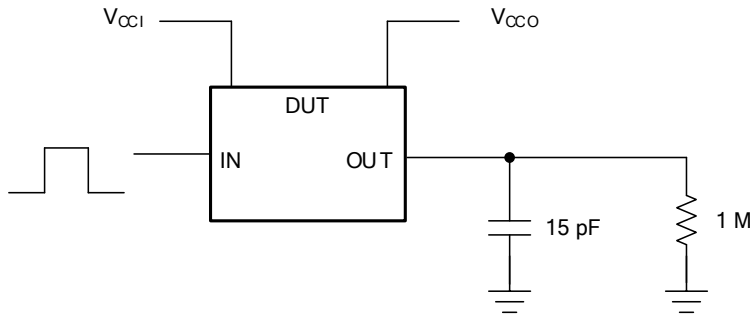


Figure 1. Data Rate, Pulse Duration, Propagation Delay, Output Rise And Fall Time Measurement Using A Push-Pull Driver

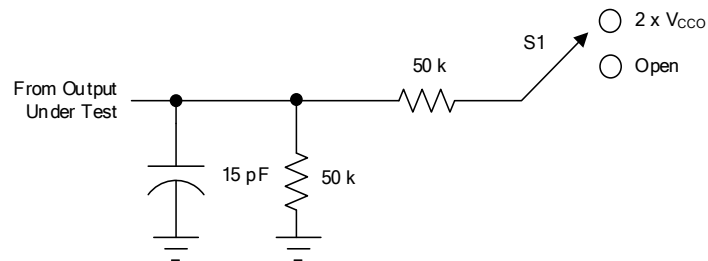


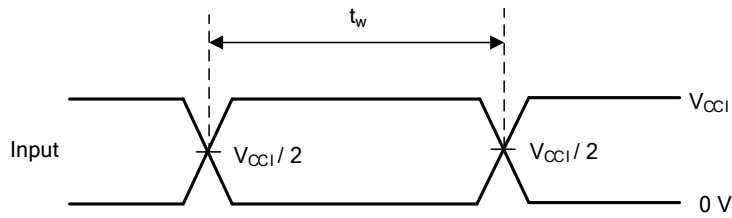
Figure 2. Load Circuit for Enable/Disable Time Measurement

Table 1. Switch Configuration for Enable/Disable Timing

| TEST | S1 |
|------------------------------------|--------------------|
| $t_{PZL}^{(1)}$, $t_{PLZ}^{(2)}$ | $2 \times V_{CC0}$ |
| $t_{PHZL}^{(1)}$, $t_{PZH}^{(2)}$ | Open |

(1) t_{PZL} and t_{PZH} are the same as t_{en} .

(2) t_{PLZ} and t_{PHZ} are the same as t_{dis} .



(1) All input pulses are measured one at a time, with one transition per measurement.

Figure 3. Voltage Waveforms Pulse Duration

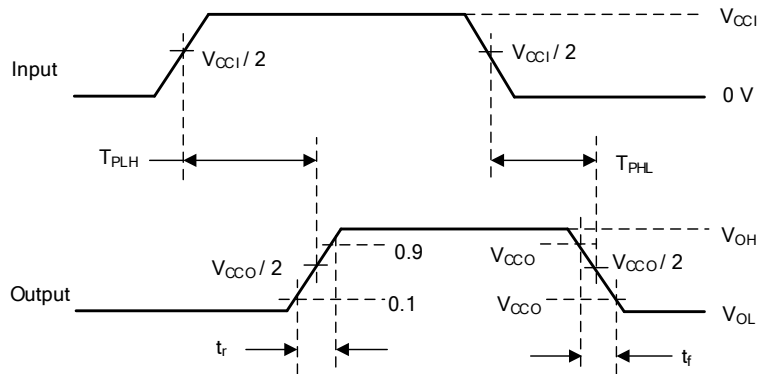


Figure 4. Voltage Waveforms Propagation Delay Times

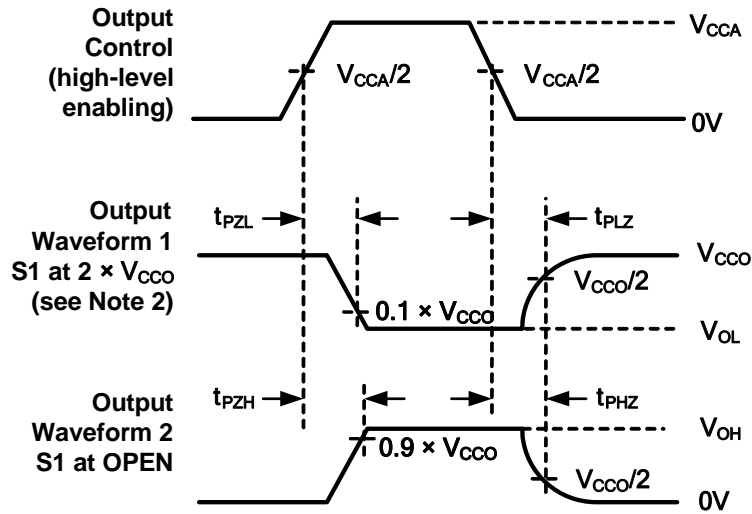


Figure 5. Voltage Waveforms Enable and Disable

Detailed Description

Overview

The RS0204 device is a 4-bit, directionless voltage-level translator specifically designed for translating logic voltage levels. The A port is able to accept I/O voltages ranging from 1.2 V to 3.6 V, while the B port can accept I/O voltages from 1.65 V to 5.5 V. 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, please refer to RS010X products.

Feature Description

Architecture

The RS0204 device architecture (see Figure 6) 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 device maintain a high or low, but are designed to be weak, so the output drivers can be overdriven by an external driver when data on the bus flows 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 70 Ω at $V_{CC0} = 1.2$ V to 1.8 V, 50 Ω at $V_{CC0} = 1.8$ V to 3.3 V, and 40 Ω at $V_{CC0} = 3.3$ V to 5 V.

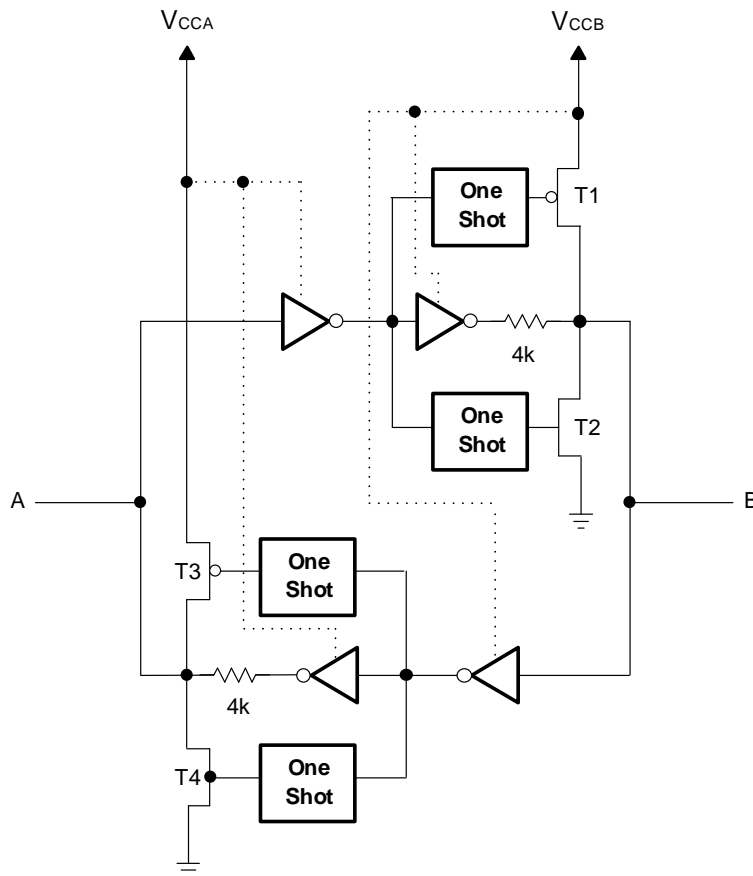
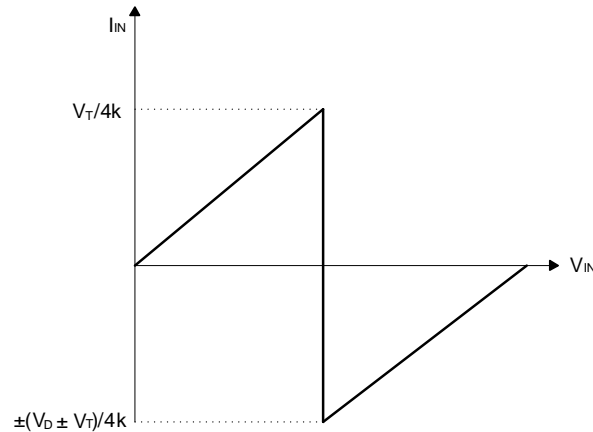


Figure 6. Architecture of RS0204 Device I/O Cell

Input Driver Requirements

Typical I_{IN} vs V_{IN} characteristics of the device are shown in Figure 7. For proper operation, the device driving the data I/Os of the RS0204 device must have driven strength of at least ± 2 mA.



- (1) V_T is the input threshold of the RS0204 device, (typically $V_{CC} / 2$).
- (2) V_D is the supply voltage of the external driver.

Figure 7. Typical I_{IN} vs V_{IN} Curve

Output Load Considerations

We recommend careful PCB layout practices with short PCB trace lengths to avoid excessive capacitive loading and to ensure that proper O.S. triggering takes place. PCB signal trace-lengths must be kept short enough such that the round-trip delay of any reflection is less than the one-shot duration. This improves signal integrity by ensuring that any reflection sees a low impedance at the driver. The O.S. circuits have been designed to stay on for approximately 10 ns. The maximum capacitance of the lumped load that can be driven also depends directly on the one-shot duration. With very heavy capacitive loads, the one-shot can time-out before the signal is driven fully to the positive rail. The O.S. duration has been set to best optimize trade-offs between dynamic I_{CC} , load driving capability, and maximum bit-rate considerations. Both PCB trace length and connectors add to the capacitance that the device output sees, so it is recommended that this lumped-load capacitance be considered to avoid O.S. retriggering, bus contention, output signal oscillations, or other adverse system-level affects.

Enable and Disable

The RS0204 device 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 actually get 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.

Pullup or Pulldown Resistors on I/O Lines

The device is designed to drive capacitive loads of up to 70 pF. The output drivers of the RS0204 device have low dc drive strength. If pullup or pulldown resistors are connected externally to the data I/Os, their values must be kept higher than 50 k Ω to ensure that they do not contend with the output drivers of the RS0204 device. For the same reason, the RS0204 device must not be used in applications such as I²C or 1-Wire where an open-drain driver is connected on the bidirectional data I/O. For these applications, use a device from the RS010X series of level translators.

Device Functional Modes

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

Application Information

The RS0204 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. It can only translate push-pull CMOS logic outputs. Any external pulldown or pullup resistors are recommended larger than 50 k Ω .

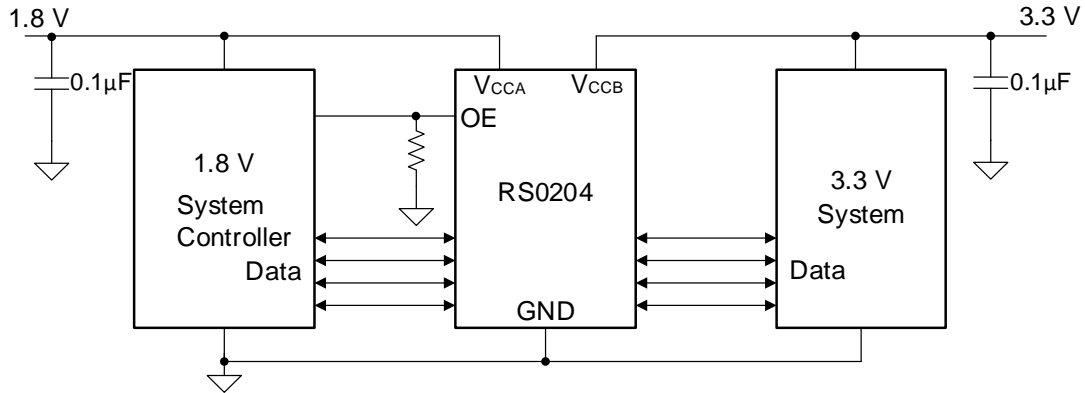
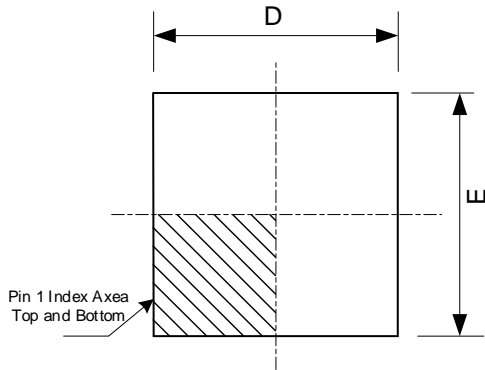
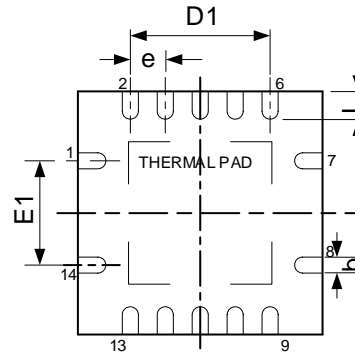
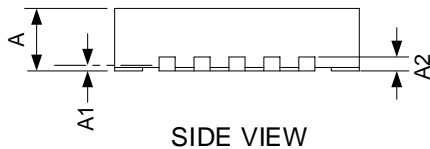


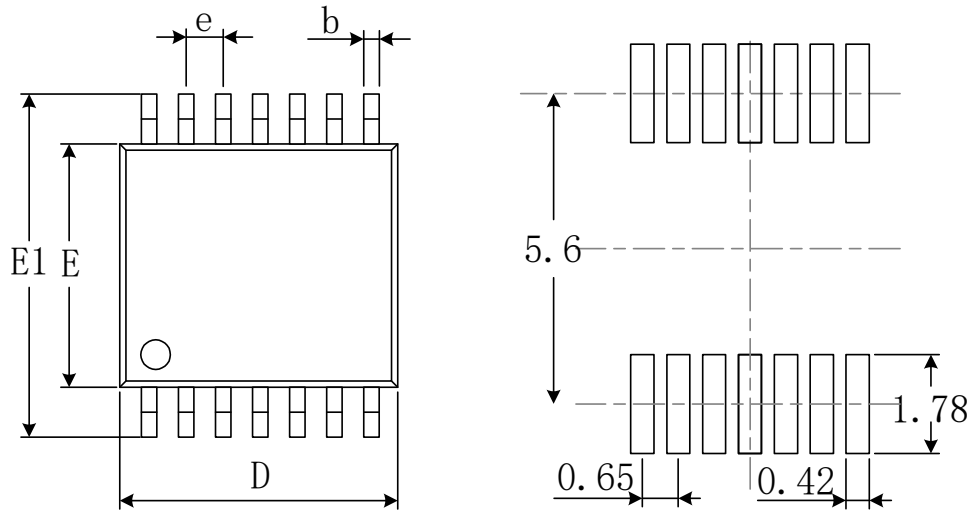
Figure 8. Typical Application Circuit

PACKAGE OUTLINE DIMENSIONS

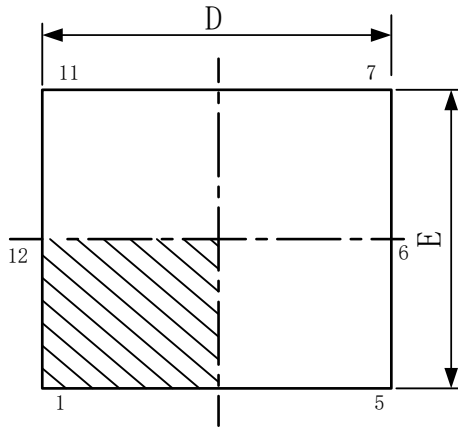
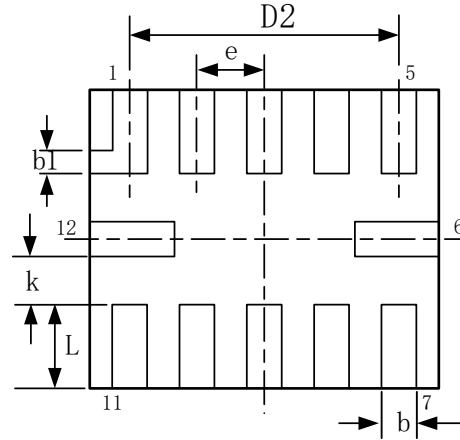
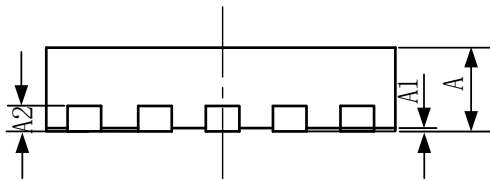
QFN3.5x3.5-14L


TOP VIEW

BOTTOM VIEW

SIDE VIEW

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 0.800 | 1.000 | 0.031 | 0.039 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.200 REF | | 0.008 REF | |
| b | 0.180 | 0.300 | 0.007 | 0.012 |
| D | 3.350 | 3.650 | 0.132 | 0.144 |
| D1 | 2.000 TYP | | 0.079 TYP | |
| E | 3.350 | 3.650 | 0.007 | 0.012 |
| E1 | 1.500 TYP | | 0.059 TYP | |
| e | 0.500 TYP | | 0.020 TYP | |
| L | 0.300 | 0.500 | 0.012 | 0.020 |

TSSOP-14

RECOMMENDED LAND PATTERN (Unit: mm)

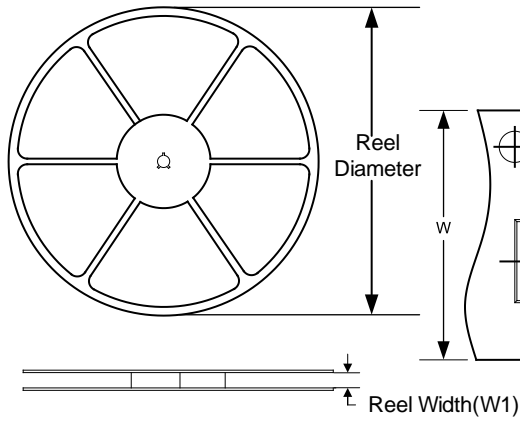
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | | 1.200 | | 0.047 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 4.860 | 5.100 | 0.191 | 0.201 |
| E | 4.300 | 4.500 | 0.169 | 0.177 |
| E1 | 6.250 | 6.550 | 0.246 | 0.258 |
| e | 0.650(BSC) | | 0.026(BSC) | |
| L | 0.500 | 0.700 | 0.020 | 0.028 |
| H | 0.250(TYP) | | 0.010(TYP) | |
| θ | 1° | 7° | 1° | 7° |

QFN1.7x2-12L

TOP VIEW

BOTTOM VIEW

SIDE VIEW

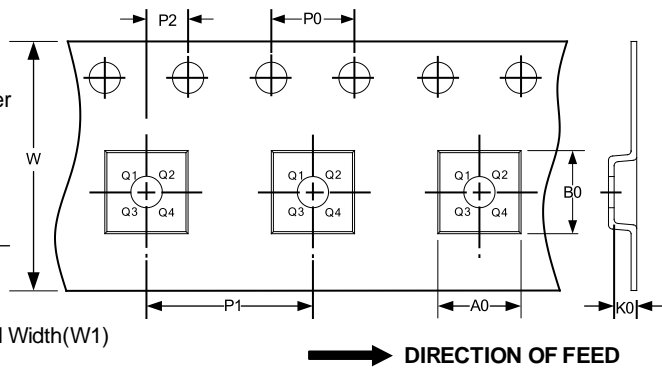
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 0.450 | 0.550 | 0.018 | 0.022 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.152 REF | | 0.006 REF | |
| D | 1.900 | 2.100 | 0.075 | 0.083 |
| E | 1.600 | 1.800 | 0.063 | 0.071 |
| D2 | 1.500 | 1.700 | 0.059 | 0.067 |
| b | 0.150 | 0.250 | 0.006 | 0.010 |
| b1 | 0.150 REF | | 0.006 REF | |
| k | 0.250 REF | | 0.010 REF | |
| e | 0.400 BSC | | 0.016 BSC | |
| L | 0.450 | 0.550 | 0.018 | 0.022 |

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1(mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|----------------|---------------|-------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| QFN3.5x3.5-14L | 13" | 12.4 | 4.0 | 4.0 | 1.10 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| TSSOP-14 | 13" | 12.4 | 6.95 | 5.60 | 1.20 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| QFN1.7x2-12L | 7" | 9.0 | 1.90 | 2.30 | 0.75 | 4.0 | 4.0 | 2.0 | 8.0 | Q1 |

单击下面可查看定价，库存，交付和生命周期等信息

[>>Runic\(润石\)](#)