

TC7PCI3212MT, TC7PCI3215MT

1. Functional Description

- 2 Differential Channel, 2:1 multiplexer/demultiplexer switch for PCI Express Gen3

2. General

The TC7PCI3212MT and TC7PCI3215MT are 2 differential channel, 1-2 multiplexer/demultiplexer for PCI Express Gen3 (8Gbps), or other high-speed interface applications.

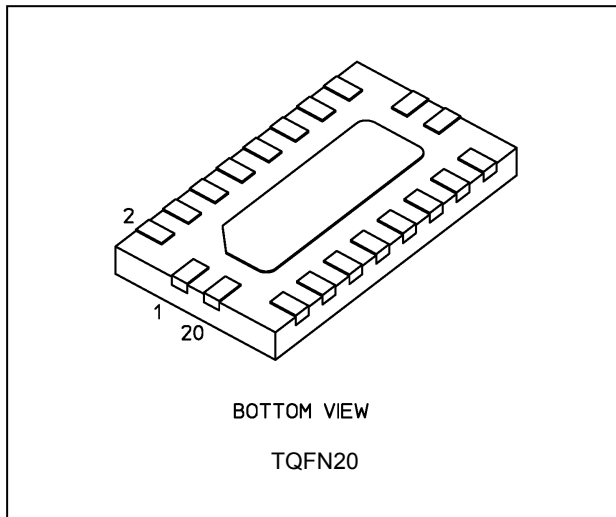
The An+/An- inputs is connected to the Bn+/Bn- or Cn+/Cn- outputs determined by the combination both the select input (SEL) and output enable (\overline{OE}). When the output enable (\overline{OE}) input is held high-level, the switches are open (high-impedance state) with regardless the state of select inputs and reducing consumption current.

All inputs are equipped with protection circuits against static discharge.

3. Features

- (1) Operating voltage: $V_{CC} = 3.0$ to 3.6 V
- (2) Switch terminal ON-capacitance: $C_{IO} = 1.5$ pF Switch On (typ.) @ $V_{CC} = 3.3$ V
- (3) ON resistance: $R_{ON} = 7.5 \Omega$ (typ.) @ $V_{CC} = 3.0$ V, $V_{IS} = 0$ V
- (4) -3dB Bandwidth: $BW = 11.5$ GHz (typ.) @ $V_{CC} = 3.3$ V
- (5) Insertion Loss: $DDIL = -1$ dB (typ.) @ $V_{CC} = 3.3$ V, $f = 4$ GHz
- (6) Off Isolation: $DDOIRR = -20$ dB (typ.) @ $V_{CC} = 3.3$ V, $f = 4$ GHz
- (7) Crosstalk: $DDNEXT = -40$ dB (typ.) @ $V_{CC} = 3.3$ V, $f = 4$ GHz
- (8) ESD performance: Machine model $\geq \pm 200$ V, Human body model $\geq \pm 2000$ V
- (9) Package: TQFN20

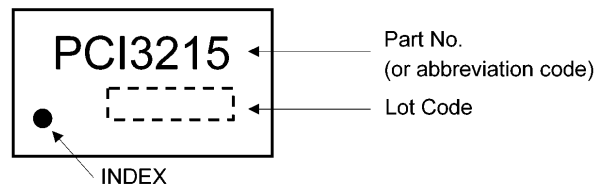
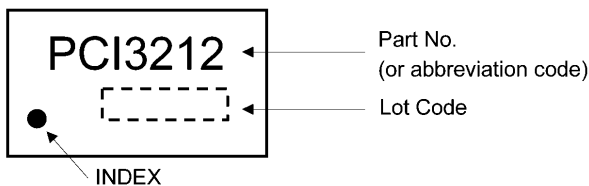
4. Packaging



5. Marking

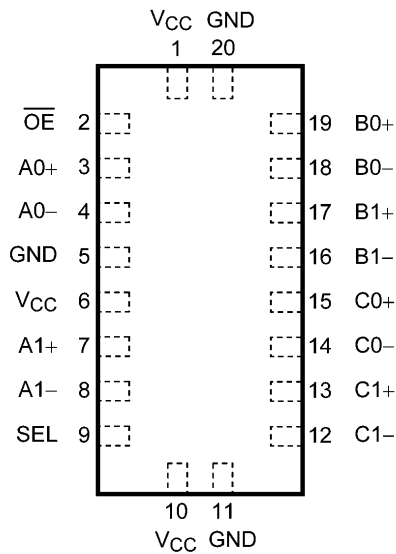
TC7PCI3212MT

TC7PCI3215MT

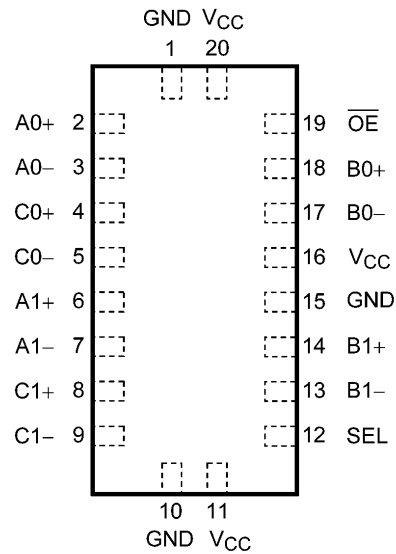


6. Pin Assignment

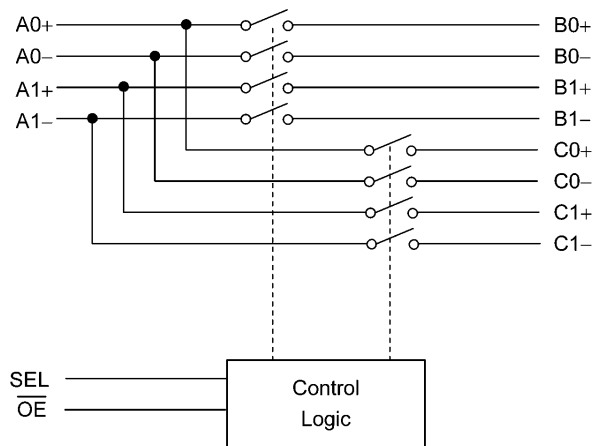
TC7PCI3212MT



TC7PCI3215MT



7. Block Diagram



8. Principle of Operation

8.1. Truth Table

| Inputs OE | Inputs SEL | Function | Function |
|--------------|---------------|--|----------|
| L | L | An+ port = Bn+ port, An- port = Bn- port | (n=0,1) |
| L | H | An+ port = Cn+ port, An- port = Cn- port | (n=0,1) |
| H | — | An, Bn, Cn port Disconnect | (n=0,1) |

—: Don't care.

9. Absolute Maximum Ratings (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|--|------------------|------|------------------------|-------------|
| Supply voltage | V_{CC} | | -0.5 to 4.6 | V |
| Input voltage (\overline{OE} , SEL) | V_{IN} | | -0.5 to 4.6 | V |
| Switch I/O voltage | V_S | | -0.5 to $V_{CC} + 0.5$ | V |
| Switch I/O current | I_S | | 50 | mA |
| Power dissipation | P_D | | 500 | mW |
| V_{CC} /ground current | I_{CC}/I_{GND} | | ± 50 | mA |
| Storage temperature | T_{stg} | | -55 to 125 | $^{\circ}C$ |

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

10. Operating Ranges (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|--|-----------|------|---------------|-------------|
| Supply voltage | V_{CC} | | 3.0 to 3.6 | V |
| Input voltage (\overline{OE} , SEL) | V_{IN} | | 0 to 3.6 | V |
| Switch I/O voltage | V_S | | 0 to V_{CC} | V |
| Operating temperature | T_{opr} | | -40 to 85 | $^{\circ}C$ |
| Input rise time | dt/dv | | 0 to 10 | ns/V |
| Input fall time | dt/dv | | 0 to 10 | ns/V |

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused control inputs must be tied to either V_{CC} or GND.

11. Electrical Characteristics

11.1. DC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to $85^{\circ}C$)

| Characteristics | Symbol | Note | Test Condition | V_{CC} (V) | Min | Typ. | Max | Unit |
|---|-----------------|----------|--|--------------|----------------------|------|----------------------|----------|
| High-level input voltage (\overline{OE} , SEL) | V_{IH} | | — | 3.0 to 3.6 | $0.65 \times V_{CC}$ | — | — | V |
| Low-level input voltage (\overline{OE} , SEL) | V_{IL} | | — | 3.0 to 3.6 | — | — | $0.35 \times V_{CC}$ | V |
| Input leakage current (\overline{OE} , SEL) | I_{IN} | | $V_{IN} = 0$ to 3.6 V | 3.0 to 3.6 | — | — | ± 1 | μA |
| Switch OFF-state leakage current | I_{SZ} | | $V_{IS} = 0$ to V_{CC} , $\overline{OE} = V_{CC}$ | 3.0 to 3.6 | — | — | ± 1 | μA |
| ON-resistance | R_{ON} | (Note 1) | $V_{IS} = 0$ V, $I_{IS} = 30$ mA | 3.0 | — | 7.5 | 11.5 | Ω |
| | R_{ON} | (Note 1) | $V_{IS} = 1.2$ V, $I_{IS} = 30$ mA | 3.0 | — | 8.5 | 13.5 | Ω |
| Difference of ON-resistance between switches (bit to bit) | ΔR_{ON} | (Note 1) | $V_{IS} = 0$ V, 1.2 V, $I_{IS} = 15$ mA | 3.0 | — | 0.1 | — | Ω |
| ON-resistance flatness | $R_{ON(Flat)}$ | (Note 1) | $V_{IS} = 0$ V to 1.2 V, $I_{IS} = 15$ mA | 3.0 | — | 1 | — | Ω |
| Quiescent supply current | I_{CC} | | $V_{IN} = V_{CC}$ or GND, $\overline{OE} = V_{CC}$ | 3.6 | — | — | 1 | μA |
| Quiescent supply current | I_{CC} | | $V_{IN} = V_{CC}$ or GND, $\overline{OE} = GND$ | 3.6 | — | 200 | 500 | μA |

Note : All typical values are at $T_a = 25^{\circ}C$.

Note 1: ON-resistance is measured by measuring the voltage drop across the switch at the indicated current.

11.2. AC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to 85 °C)

| Characteristics | Symbol | Note | Test Condition | V_{CC} (V) | Min | Typ. | Max | Unit |
|--|-------------------|----------|---|---------------|-----|------|-----|---------|
| Propagation delay time | t_{PLH}/t_{PHL} | (Note 1) | $C_L = 5$ pF See Fig. 12.1 | 3.3 ± 0.3 | — | 0.1 | — | ns |
| Turn-ON time (SEL to Output) | t_{on} | | $R_L = 50$ Ω , $C_L = 5$ pF See Fig. 12.2 | 3.3 ± 0.3 | — | 10 | 15 | ns |
| Turn-ON time (\overline{OE} to Output) | t_{on} | | $R_L = 50$ Ω , $C_L = 5$ pF See Fig. 12.2 | 3.3 ± 0.3 | — | 37 | 50 | μ s |
| Turn-OFF time (SEL to Output) | t_{off} | | $R_L = 50$ Ω , $C_L = 5$ pF See Fig. 12.2 | 3.3 ± 0.3 | — | 3.5 | 5 | ns |
| Turn-OFF time (\overline{OE} to Output) | t_{off} | | $R_L = 50$ Ω , $C_L = 5$ pF See Fig. 12.2 | 3.3 ± 0.3 | — | 5 | 6.5 | ns |
| Break before make | TBBM | | $R_L = 50$ Ω , $C_L = 5$ pF See Fig. 12.3 | 3.3 ± 0.3 | 3 | — | 9 | ns |
| Output skew (bit to bit) | $t_{SK(b)}$ | (Note 1) | $C_L = 5$ pF See Fig. 12.4 | 3.3 ± 0.3 | — | 5 | — | ps |
| Output skew (channel to channel) | $t_{SK(CH)}$ | (Note 1) | $C_L = 5$ pF See Fig. 12.5 | 3.3 ± 0.3 | — | 10 | — | ps |
| Differential OFF isolation | DDOIRR | (Note 1) | $R_T = 50$ Ω , $f = 4$ GHz See Fig. 12.6 | 3.3 ± 0.3 | — | -20 | — | dB |
| Differential Near-end crosstalk | DDNEXT | (Note 1) | $R_T = 50$ Ω , $f = 4$ GHz See Fig. 12.7 | 3.3 ± 0.3 | — | -40 | — | dB |
| Differential return loss | DDRL | (Note 1) | $R_T = 50$ Ω , $f = 4$ GHz See Fig. 12.8 | 3.3 ± 0.3 | — | -20 | — | dB |
| Differential insertion loss | DDIL | (Note 1) | $R_T = 50$ Ω , $f = 4$ GHz See Fig. 12.8 | 3.3 ± 0.3 | — | -1 | — | dB |
| -3dB Bandwidth | BW | (Note 1) | $R_T = 50$ Ω , $C_L = 0$ pF See Fig. 12.8 | 3.3 ± 0.3 | — | 11.5 | — | GHz |

Note : All typical values are at $T_a = 25$ °C.

Note 1: This parameter is guaranteed by design.

11.3. Capacitive Characteristics (Note) (Unless otherwise specified, $T_a = 25$ °C)

| Characteristics | Symbol | Note | Test Condition | V_{CC} (V) | Typ. | Unit |
|---|-----------|------|---|--------------|------|------|
| Input capacitance (\overline{OE} , SEL) | C_{IN} | | $V_{IN} = 0$ V | 3.3 | 3 | pF |
| Switch terminal OFF-capacitance (A_n+ , A_n-) | $C_{I/O}$ | | $\overline{OE} = V_{CC}$, $V_{IS} = 0$ V | 3.3 | 0.8 | pF |
| Switch terminal OFF-capacitance (B_n+ , B_n- , C_n+ , C_n-) | $C_{I/O}$ | | $\overline{OE} = V_{CC}$, $V_{IS} = 0$ V | 3.3 | 0.5 | pF |
| Switch terminal ON-capacitance | $C_{I/O}$ | | $\overline{OE} = GND$, $V_{IS} = 0$ V | 3.3 | 1.5 | pF |

Note: Parameter guaranteed by design.

12. AC Electrical Test Circuit (Fig)

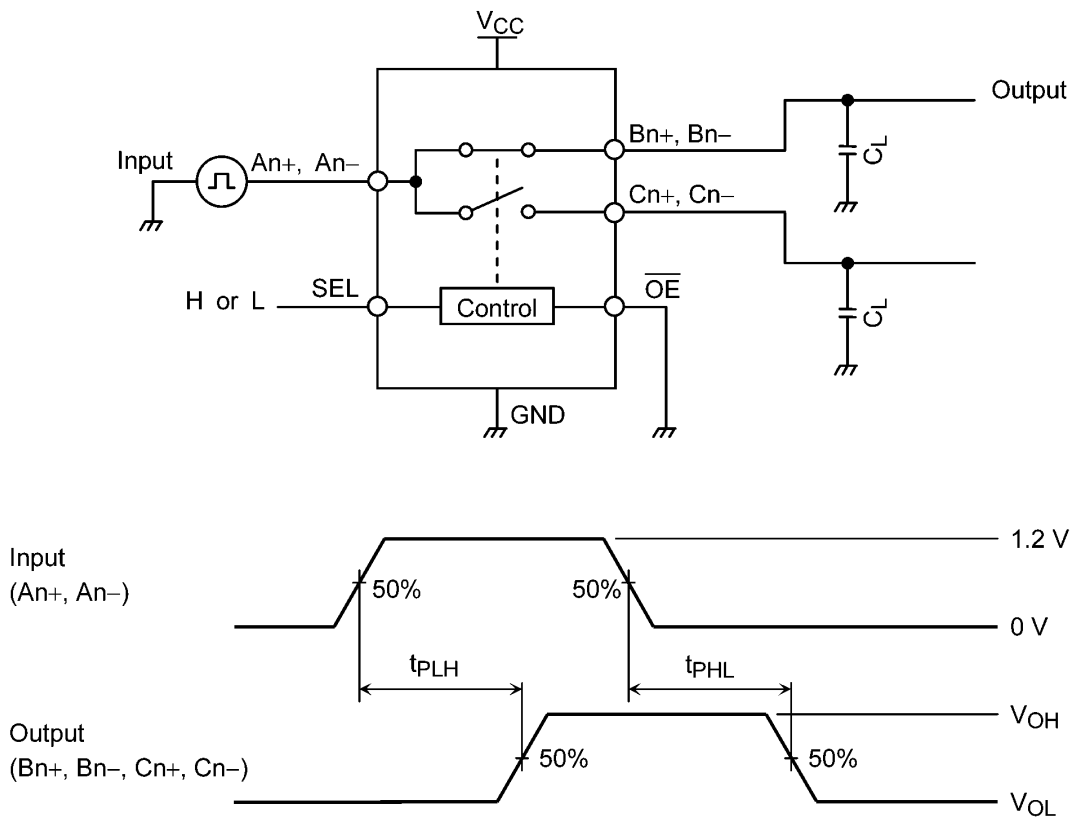


Fig. 12.1 Propagation delay time

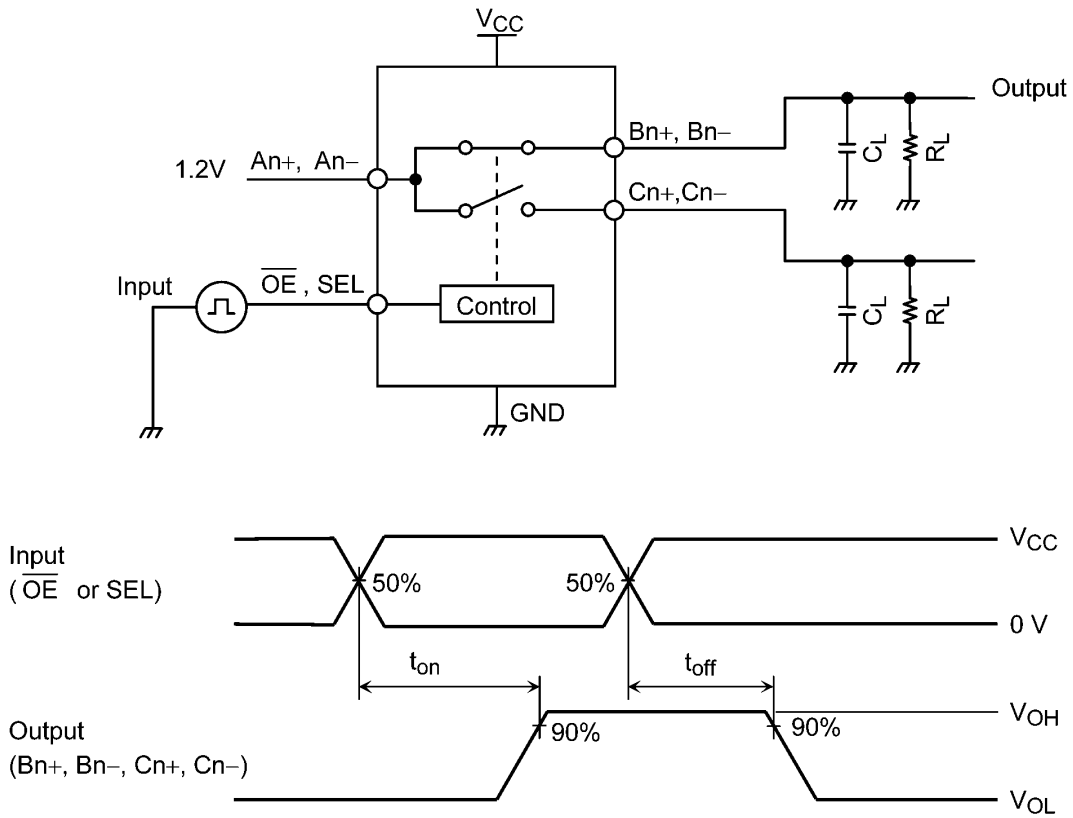


Fig. 12.2 Turn-ON and Turn-OFF time

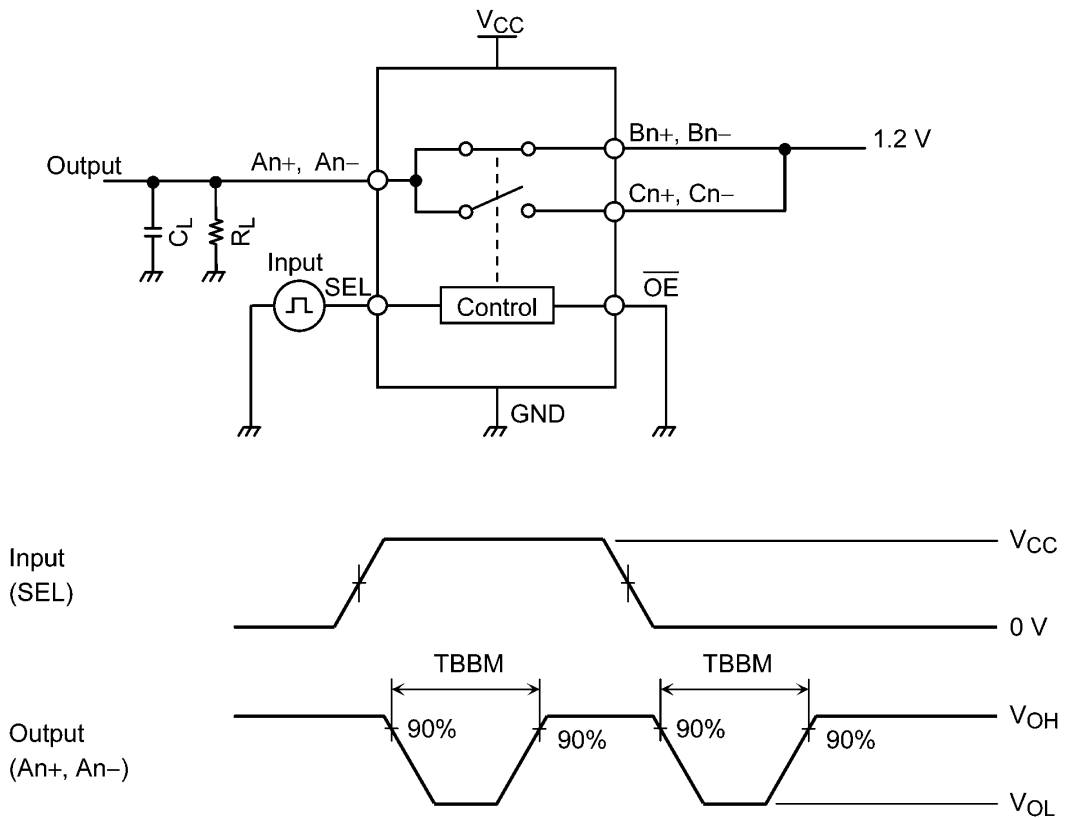


Fig. 12.3 Break before make

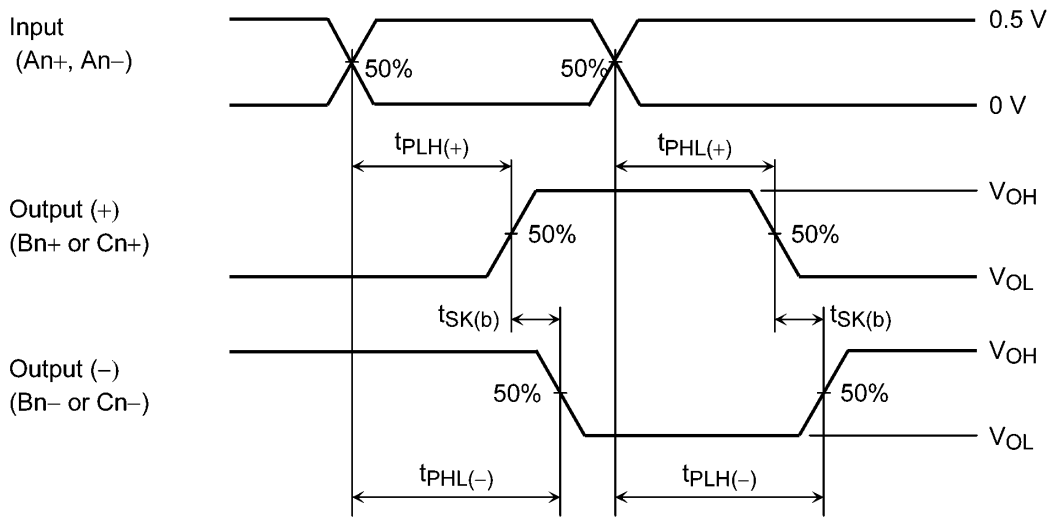
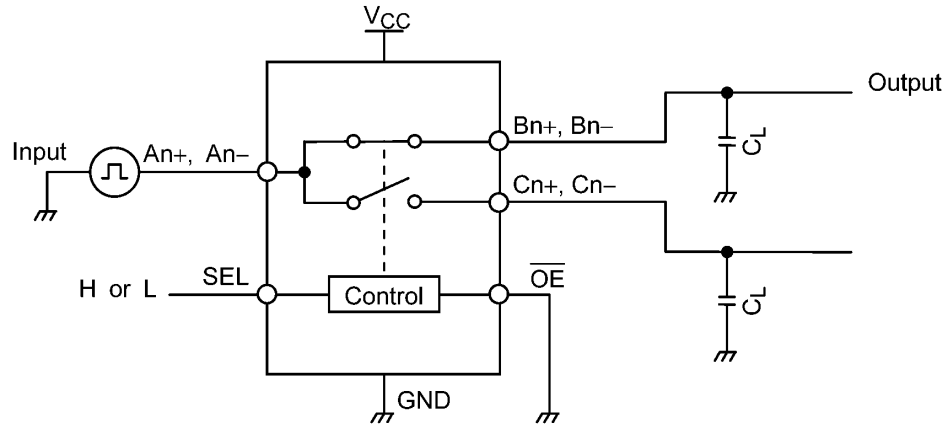


Fig. 12.4 Output skew (bit to bit)

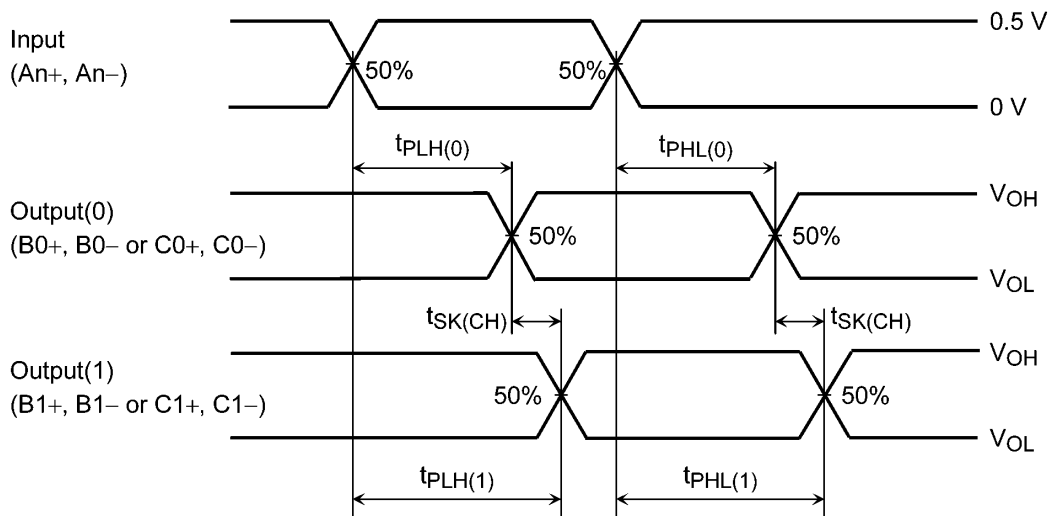
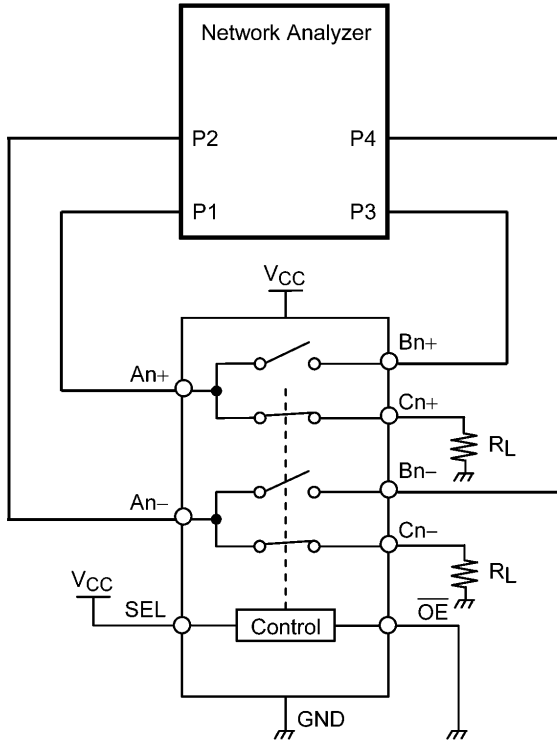
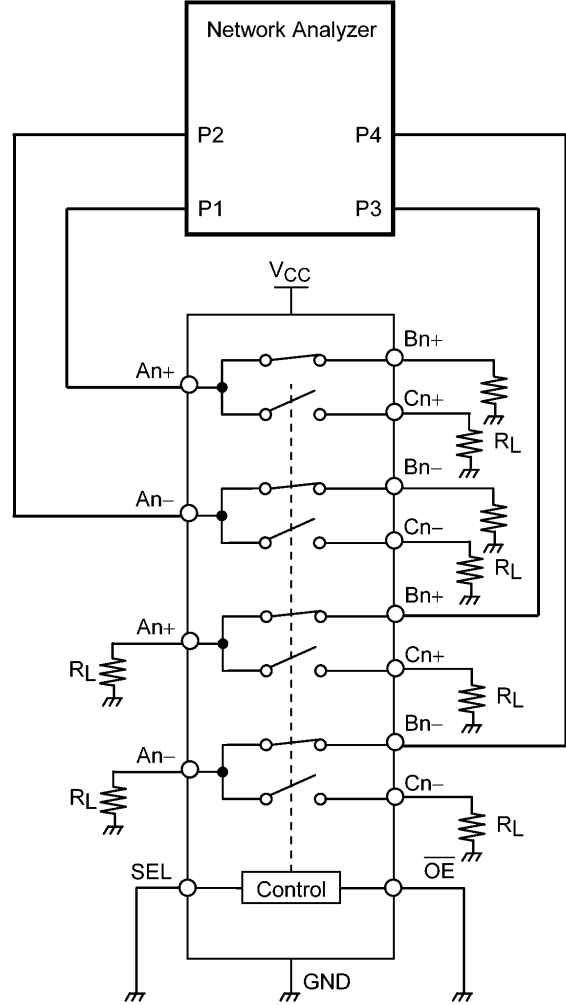


Fig. 12.5 Output skew (channel to channel)



$R_L = 50\ \Omega$
 All unused ports are connected to GND through $50\ \Omega$ pull-down resistors.

Fig. 12.6 Differential OFF isolation



$R_L = 50\ \Omega$
 All unused ports are connected to GND through $50\ \Omega$ pull-down resistors.

Fig. 12.7 Differential Near-end crosstalk

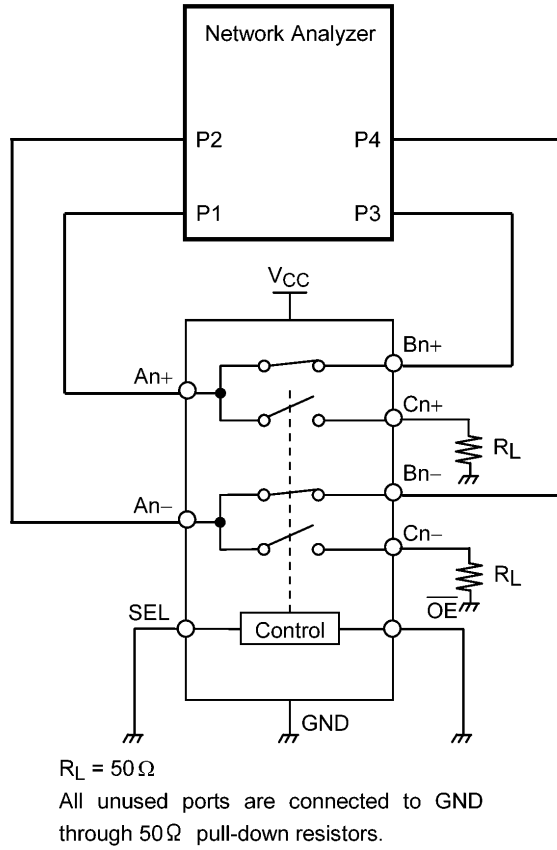
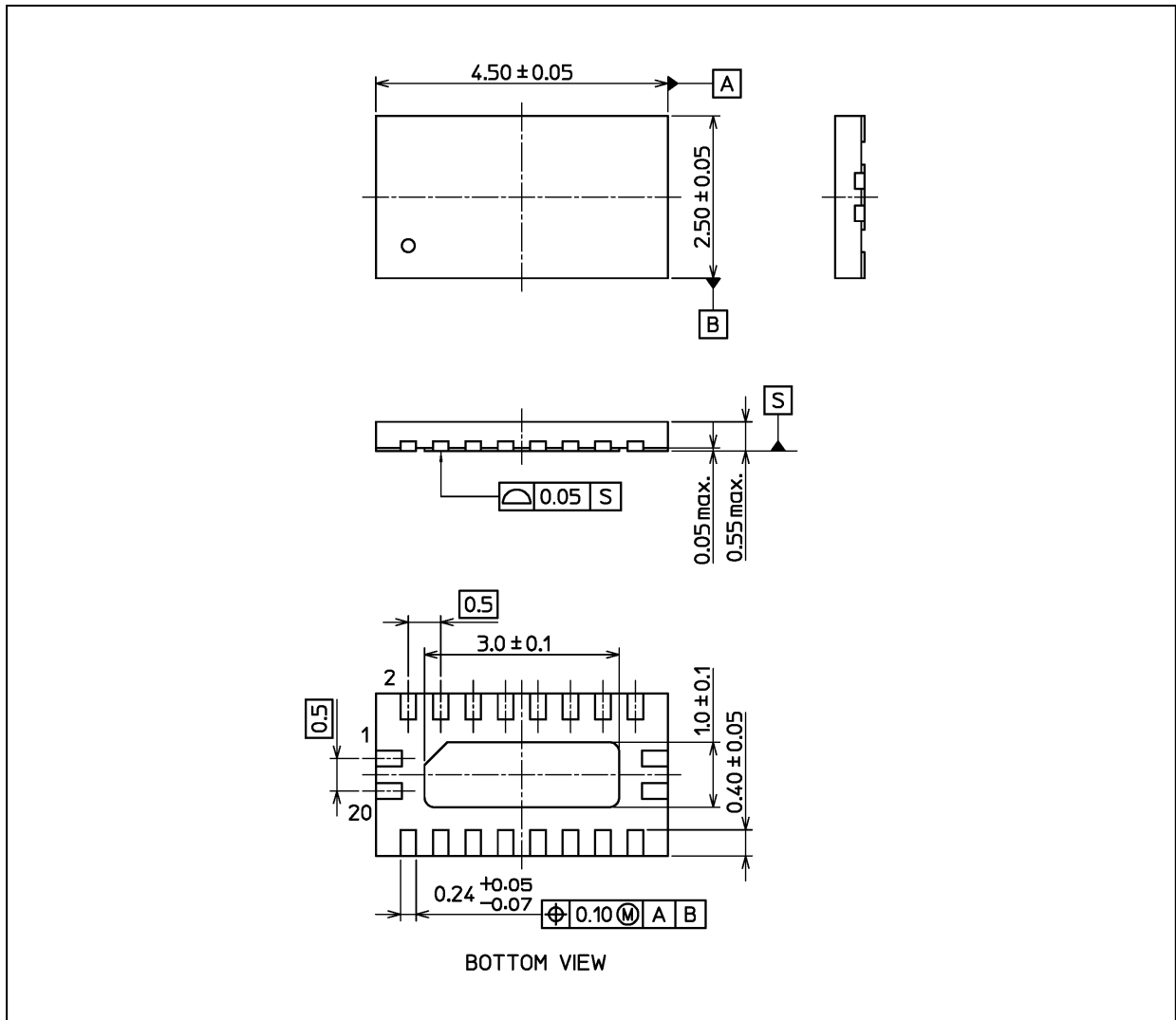


Fig. 12.8 Differential return loss, Differential insertion loss, -3dB Bandwidth

Package Dimensions

Unit: mm



Weight: 0.017 g (typ.)

| Package Name(s) |
|---------------------------------|
| TOSHIBA: P-UQFN20-0305-0.50-001 |
| Nickname: TQFN20 |

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