

# TC7MP3125FK

## 1. Functional Description

- Low-Voltage, Low-Power 2-Bit × 2 Dual-Supply Bus Transceiver

## 2. General

The TC7MP3125FK is an advanced high-speed CMOS 4-bit dual supply voltage interface bus transceiver fabricated with silicon gate CMOS technology.

All inputs and outputs have tolerant function, and can be applied up to 3.6 V at power down mode.

The input consists of two same 2-bit configuration and it can be used as dual 2-bit configurations or single 4-bit configuration.

When the DIR input that changes transmission direction is H level, A-bus works as input and B-bus works as output, and when the DIR is L level, A-bus works as output and B-bus works as input.

When the Enable input  $\overline{OE}$  is H level, both A-bus and B-bus become to floating state (high-impedance).

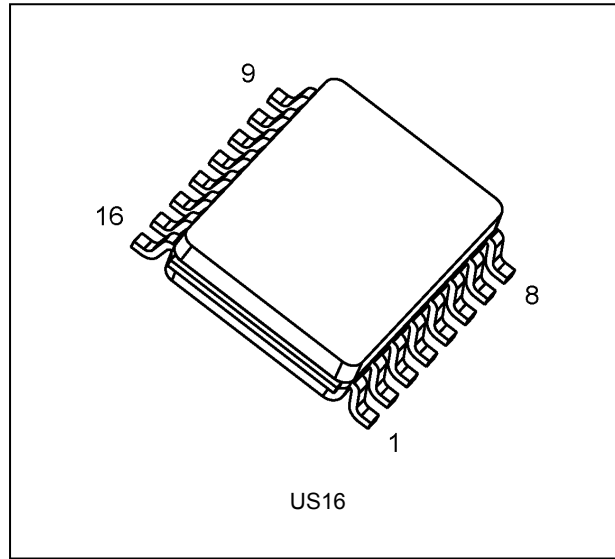
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

## 3. Features (Note)

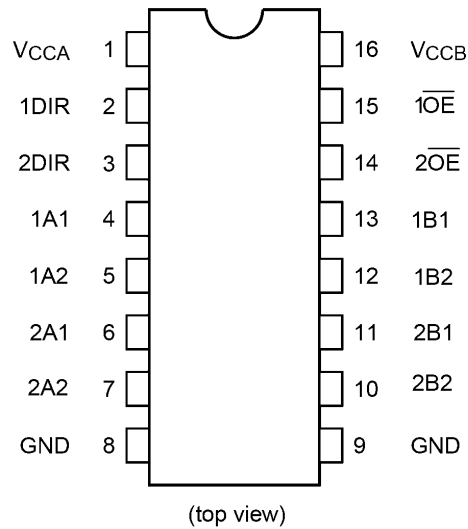
- Operating voltage: 1.2 V to 1.8 V / 1.2 V to 2.5 V / 1.2 V to 3.3 V / 1.5 V to 2.5 V  
1.5 V to 3.3 V / 1.8 V to 2.5 V / 1.8 V to 3.3 V / 2.5 V to 3.3 V  
bidirectional interface
- High-speed operation:  $t_{pd} = 6.8$  ns (max) ( $V_{CCA} = 2.5 \pm 0.2$  V,  $V_{CCB} = 3.3 \pm 0.3$  V)  
 $t_{pd} = 8.9$  ns (max) ( $V_{CCA} = 1.8 \pm 0.15$  V,  $V_{CCB} = 3.3 \pm 0.3$  V)  
 $t_{pd} = 10.3$  ns (max) ( $V_{CCA} = 1.5 \pm 0.1$  V,  $V_{CCB} = 3.3 \pm 0.3$  V)  
 $t_{pd} = 61$  ns (max) ( $V_{CCA} = 1.2 \pm 0.1$  V,  $V_{CCB} = 3.3 \pm 0.3$  V)  
 $t_{pd} = 9.5$  ns (max) ( $V_{CCA} = 1.8 \pm 0.15$  V,  $V_{CCB} = 2.5 \pm 0.2$  V)  
 $t_{pd} = 10.8$  ns (max) ( $V_{CCA} = 1.5 \pm 0.1$  V,  $V_{CCB} = 2.5 \pm 0.2$  V)  
 $t_{pd} = 60$  ns (max) ( $V_{CCA} = 1.2 \pm 0.1$  V,  $V_{CCB} = 2.5 \pm 0.2$  V)  
 $t_{pd} = 58$  ns (max) ( $V_{CCA} = 1.2 \pm 0.1$  V,  $V_{CCB} = 1.8 \pm 0.15$  V)
- Output current:  $|I_{OH}|/|I_{OL}| = 12$  mA (min) ( $V_{CC} = 3.0$  V)  
 $|I_{OH}|/|I_{OL}| = 9$  mA (min) ( $V_{CC} = 2.3$  V)  
 $|I_{OH}|/|I_{OL}| = 3$  mA (min) ( $V_{CC} = 1.65$  V)  
 $|I_{OH}|/|I_{OL}| = 1$  mA (min) ( $V_{CC} = 1.4$  V)
- Ultra-small package: VSSOP (US16)
- Low power dissipation: By using the new circuit, the power consumption is reduced significantly when  $\overline{OE} = "H"$ .  
Suitable for battery-driven applications such as PDAs and cellular phones.
- Floating of A-bus and B-bus is permitted (when  $\overline{OE} = "H"$ ).
- 3.6 V tolerance and power-down protection are provided to all inputs and outputs.

Note: Do not apply a signal to any bus pins when it is in the output mode. Damage may result.

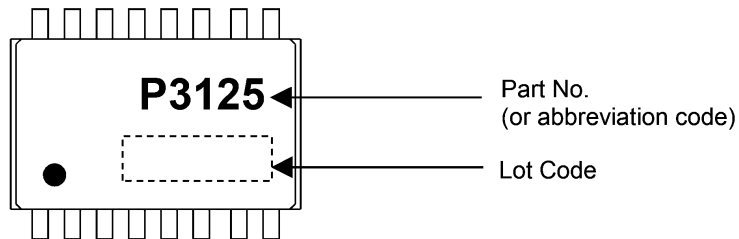
## 4. Packaging



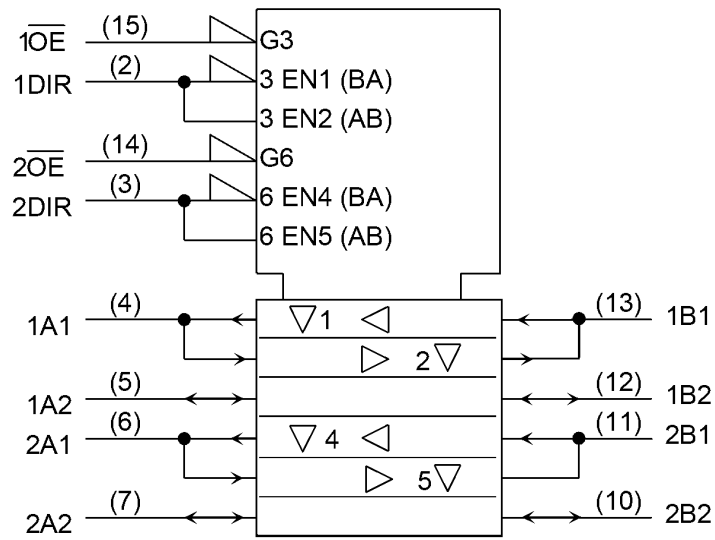
## 5. Pin Assignment



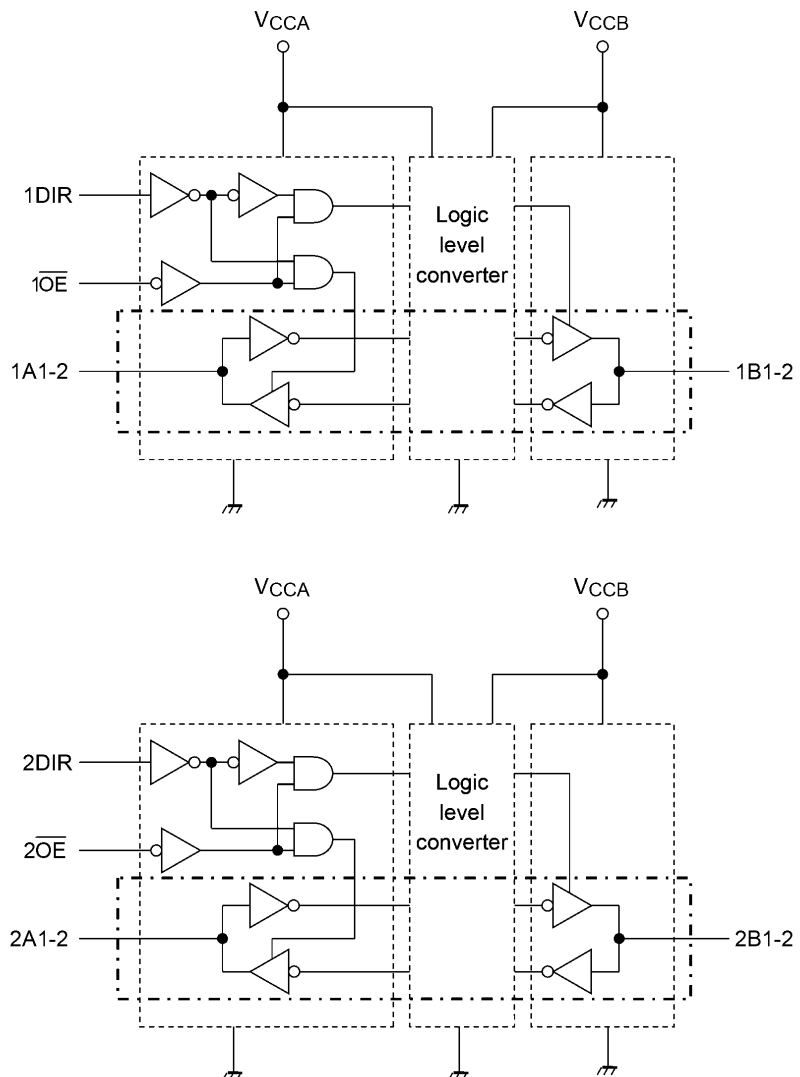
## 6. Marking



### 7. IEC Logic Symbol



### 8. Block Diagram



### 9. Truth Table

Input 1OE	Input 1DIR	Function Bus 1A1-1A2	Function Bus 1B1-1B2	Outputs
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z	Z	Z

Input 2OE	Input 2DIR	Function Bus 2A1-2A2	Function Bus 2B1-2B2	Outputs
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z	Z	Z

X: Don't care

Z: High impedance

### 10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CCA}$	(Note 1)	-0.5 to 4.6	V
	$V_{CCB}$		-0.5 to 4.6	
Input voltage (DIR, OE)	$V_{IN}$		-0.5 to 4.6	V
Bus I/O voltage	$V_{IOA}$	(Note 2)	-0.5 to 4.6	V
		(Note 3)	-0.5 to $V_{CCA} + 0.5$	
	$V_{IOB}$	(Note 2)	-0.5 to 4.6	
		(Note 3)	-0.5 to $V_{CCB} + 0.5$	
Input diode current	$I_{IK}$		-50	mA
I/O diode current	$I_{I/OK}$	(Note 4)	$\pm 50$	mA
Output current	$I_{OUTA}$		$\pm 25$	mA
	$I_{OUTB}$		$\pm 25$	
$V_{CC}$ /ground current per supply pin	$I_{CCA}$		$\pm 50$	mA
	$I_{CCB}$		$\pm 50$	
Power dissipation	$P_D$		180	mW
Storage temperature	$T_{stg}$		-65 to 150	$^{\circ}\text{C}$

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).

Note 1: Don't supply a voltage to  $V_{CCB}$  pin when  $V_{CCA}$  is in the OFF state.

Note 2: Output in OFF state.

Note 3: High (H) or Low (L) state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 4:  $V_{OUT} < \text{GND}$ ,  $V_{OUT} > V_{CC}$

### 11. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	$V_{CCA}$	(Note 1)	—	1.1 to 2.7	V
	$V_{CCB}$			1.65 to 3.6	
Input voltage(DIR, $\overline{OE}$ )	$V_{IN}$		—	0 to 3.6	V
Bus I/O voltage	$V_{IOA}$	(Note 2)	—	0 to 3.6	V
		(Note 3)		0 to $V_{CCA}$	
	$V_{IOB}$	(Note 2)		0 to 3.6	
		(Note 3)		0 to $V_{CCB}$	
Output current	$I_{OUTA}$		$V_{CCA} = 2.3$ to $2.7$ V	$\pm 9$	mA
			$V_{CCA} = 1.65$ to $1.95$ V	$\pm 3$	
			$V_{CCA} = 1.4$ to $1.6$ V	$\pm 1$	
	$I_{OUTB}$		$V_{CCB} = 3.0$ to $3.6$ V	$\pm 12$	
			$V_{CCB} = 2.3$ to $2.7$ V	$\pm 9$	
			$V_{CCB} = 1.65$ to $1.95$ V	$\pm 3$	
Operating temperature	$T_{opr}$		—	-40 to 85	°C
Input rise and fall times	dt/dv		$V_{IN} = 0.8$ to $2.0$ V, $V_{CCA} = 2.5$ V, $V_{CCB} = 3.0$ V	0 to 10	ns/V

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

Note 1: Don't use at  $V_{CCA} > V_{CCB}$ .

Note 2: Output in OFF state.

Note 3: High (H) or Low (L) state.

### 12. Electrical Characteristics

#### 12.1. DC Characteristics

##### 12.1.1. $2.3\text{ V} \leq V_{CCA} \leq 2.7\text{ V}$ , $2.7\text{ V} < V_{CCB} \leq 3.6\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	2.3 to 2.7	2.7 to 3.6	1.6	—	V	
	$V_{IHB}$	Bn	2.3 to 2.7	2.7 to 3.6	2.0	—		
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	2.3 to 2.7	2.7 to 3.6	—	0.7	V	
	$V_{ILB}$	Bn	2.3 to 2.7	2.7 to 3.6	—	0.8		
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\text{ }\mu\text{A}$	2.3 to 2.7	2.7 to 3.6	$V_{CCA} - 0.2$	—	V
			$I_{OHA} = -9\text{ mA}$	2.3	2.7 to 3.6	1.7	—	
	$V_{OHB}$		$I_{OHB} = -100\text{ }\mu\text{A}$	2.3 to 2.7	2.7 to 3.6	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -12\text{ mA}$	2.3 to 2.7	3.0	2.2	—	
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\text{ }\mu\text{A}$	2.3 to 2.7	2.7 to 3.6	—	0.2	V
			$I_{OLA} = 9\text{ mA}$	2.3	2.7 to 3.6	—	0.6	
	$V_{OLB}$		$I_{OLB} = 100\text{ }\mu\text{A}$	2.3 to 2.7	2.7 to 3.6	—	0.2	
			$I_{OLB} = 12\text{ mA}$	2.3 to 2.7	3.0	—	0.55	
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	2.3 to 2.7	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	2.3 to 2.7	2.7 to 3.6	—	$\pm 2.0$		
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = $0$ to $3.6\text{ V}$	2.3 to 2.7	2.7 to 3.6	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	2.3 to 2.7	0	—	2.0		
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	2.3 to 2.7	Open	—	2.0		
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	2.3 to 2.7	2.7 to 3.6	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	2.3 to 2.7	2.7 to 3.6	—	2.0		
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	2.3 to 2.7	2.7 to 3.6	—	$\pm 2.0$		
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	2.3 to 2.7	2.7 to 3.6	—	$\pm 2.0$		
	$I_{CCTB}$	$V_{INB} = V_{CCB} - 0.6\text{ V}$ per input	2.3 to 2.7	2.7 to 3.6	—	750.0		

### 12.1.2. $1.65\text{ V} \leq V_{CCA} < 2.3\text{ V}$ , $2.7\text{ V} < V_{CCB} \leq 3.6\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	1.65 to 2.3	2.7 to 3.6	$0.65 \times V_{CCA}$	—	V	
	$V_{IHB}$	Bn	1.65 to 2.3	2.7 to 3.6	2.0	—	V	
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	1.65 to 2.3	2.7 to 3.6	—	$0.35 \times V_{CCA}$	V	
	$V_{ILB}$	Bn	1.65 to 2.3	2.7 to 3.6	—	0.8	V	
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\text{ }\mu\text{A}$	1.65 to 2.3	2.7 to 3.6	$V_{CCA} - 0.2$	—	V
			$I_{OHA} = -3\text{ mA}$	1.65	2.7 to 3.6	1.25	—	V
	$V_{OHB}$		$I_{OHB} = -100\text{ }\mu\text{A}$	1.65 to 2.3	2.7 to 3.6	$V_{CCB} - 0.2$	—	V
			$I_{OHB} = -12\text{ mA}$	1.65 to 2.3	3.0	2.2	—	V
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\text{ }\mu\text{A}$	1.65 to 2.3	2.7 to 3.6	—	0.2	V
			$I_{OLA} = 3\text{ mA}$	1.65	2.7 to 3.6	—	0.3	V
	$V_{OLB}$		$I_{OLB} = 100\text{ }\mu\text{A}$	1.65 to 2.3	2.7 to 3.6	—	0.2	V
			$I_{OLB} = 12\text{ mA}$	1.65 to 2.3	3.0	—	0.55	V
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.65 to 2.3	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.65 to 2.3	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = $0$ to $3.6\text{ V}$	1.65 to 2.3	2.7 to 3.6	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	1.65 to 2.3	0	—	2.0	$\mu\text{A}$	
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	1.65 to 2.3	Open	—	2.0	$\mu\text{A}$	
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.65 to 2.3	2.7 to 3.6	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.65 to 2.3	2.7 to 3.6	—	2.0	$\mu\text{A}$	
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{CCTB}$	$V_{INB} = V_{CCB} - 0.6\text{ V}$ per input	1.65 to 2.3	2.7 to 3.6	—	750.0	$\mu\text{A}$	

### 12.1.3. $1.4\text{ V} \leq V_{CCA} < 1.65\text{ V}$ , $2.7\text{ V} < V_{CCB} \leq 3.6\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	1.4 to 1.65	2.7 to 3.6	$0.65 \times V_{CCA}$	—	V	
	$V_{IHB}$	Bn	1.4 to 1.65	2.7 to 3.6	2.0	—		
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	1.4 to 1.65	2.7 to 3.6	—	$0.30 \times V_{CCA}$	V	
	$V_{ILB}$	Bn	1.4 to 1.65	2.7 to 3.6	—	0.8		
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\ \mu\text{A}$	1.4 to 1.65	2.7 to 3.6	$V_{CCA} - 0.2$	—	V
			$I_{OHA} = -1\text{ mA}$	1.4	2.7 to 3.6	1.05	—	
	$V_{OHB}$		$I_{OHB} = -100\ \mu\text{A}$	1.4 to 1.65	2.7 to 3.6	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -12\text{ mA}$	1.4 to 1.65	3.0	2.2	—	
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\ \mu\text{A}$	1.4 to 1.65	2.7 to 3.6	—	0.2	V
			$I_{OLA} = 1\text{ mA}$	1.4	2.7 to 3.6	—	0.35	
	$V_{OLB}$		$I_{OLB} = 100\ \mu\text{A}$	1.4 to 1.65	2.7 to 3.6	—	0.2	
			$I_{OLB} = 12\text{ mA}$	1.4 to 1.65	3.0	—	0.55	
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.4 to 1.65	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.4 to 1.65	2.7 to 3.6	—	$\pm 2.0$		
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = $0$ to $3.6\text{ V}$	1.4 to 1.65	2.7 to 3.6	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	1.4 to 1.65	0	—	2.0		
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	1.4 to 1.65	Open	—	2.0		
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.4 to 1.65	2.7 to 3.6	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.4 to 1.65	2.7 to 3.6	—	2.0		
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.4 to 1.65	2.7 to 3.6	—	$\pm 2.0$		
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.4 to 1.65	2.7 to 3.6	—	$\pm 2.0$		
	$I_{CCTB}$	$V_{INB} = V_{CCB} - 0.6\text{ V}$ per input	1.4 to 1.65	2.7 to 3.6	—	750.0		

### 12.1.4. $1.1\text{ V} \leq V_{CCA} < 1.4\text{ V}$ , $2.7\text{ V} < V_{CCB} \leq 3.6\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	1.1 to 1.4	2.7 to 3.6	$0.65 \times V_{CCA}$	—	V	
	$V_{IHB}$	Bn	1.1 to 1.4	2.7 to 3.6	2.0	—	V	
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	1.1 to 1.4	2.7 to 3.6	—	$0.30 \times V_{CCA}$	V	
	$V_{ILB}$	Bn	1.1 to 1.4	2.7 to 3.6	—	0.8	V	
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\text{ }\mu\text{A}$	1.1 to 1.4	2.7 to 3.6	$V_{CCA} - 0.2$	—	V
	$V_{OHB}$		$I_{OHB} = -100\text{ }\mu\text{A}$	1.1 to 1.4	2.7 to 3.6	$V_{CCB} - 0.2$	—	V
	$V_{OHB}$		$I_{OHB} = -12\text{ mA}$	1.1 to 1.4	3.0	2.2	—	V
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\text{ }\mu\text{A}$	1.1 to 1.4	2.7 to 3.6	—	0.2	V
	$V_{OLB}$		$I_{OLB} = 100\text{ }\mu\text{A}$	1.1 to 1.4	2.7 to 3.6	—	0.2	V
	$V_{OLB}$		$I_{OLB} = 12\text{ mA}$	1.1 to 1.4	3.0	—	0.55	V
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.1 to 1.4	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.1 to 1.4	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = $0$ to $3.6\text{ V}$	1.1 to 1.4	2.7 to 3.6	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	1.1 to 1.4	0	—	2.0	$\mu\text{A}$	
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	1.1 to 1.4	Open	—	2.0	$\mu\text{A}$	
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.1 to 1.4	2.7 to 3.6	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.1 to 1.4	2.7 to 3.6	—	2.0	$\mu\text{A}$	
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.7 to 3.6	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{CCTB}$	$V_{INB} = V_{CCB} - 0.6\text{ V}$ per input	1.1 to 1.4	2.7 to 3.6	—	750.0	$\mu\text{A}$	

### 12.1.5. $1.65\text{ V} \leq V_{CCA} < 2.3\text{ V}$ , $2.3\text{ V} \leq V_{CCB} \leq 2.7\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	1.65 to 2.3	2.3 to 2.7	$0.65 \times V_{CCA}$	—	V	
	$V_{IHB}$	Bn	1.65 to 2.3	2.3 to 2.7	1.6	—	V	
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	1.65 to 2.3	2.3 to 2.7	—	$0.35 \times V_{CCA}$	V	
	$V_{ILB}$	Bn	1.65 to 2.3	2.3 to 2.7	—	0.7	V	
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\text{ }\mu\text{A}$	1.65 to 2.3	2.3 to 2.7	$V_{CCA} - 0.2$	—	V
			$I_{OHA} = -3\text{ mA}$	1.65	2.3 to 2.7	1.25	—	V
	$V_{OHB}$		$I_{OHB} = -100\text{ }\mu\text{A}$	1.65 to 2.3	2.3 to 2.7	$V_{CCB} - 0.2$	—	V
			$I_{OHB} = -9\text{ mA}$	1.65 to 2.3	2.3	1.7	—	V
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\text{ }\mu\text{A}$	1.65 to 2.3	2.3 to 2.7	—	0.2	V
			$I_{OLA} = 3\text{ mA}$	1.65	2.3 to 2.7	—	0.3	V
	$V_{OLB}$		$I_{OLB} = 100\text{ }\mu\text{A}$	1.65 to 2.3	2.3 to 2.7	—	0.2	V
			$I_{OLB} = 9\text{ mA}$	1.65 to 2.3	2.3	—	0.6	V
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.65 to 2.3	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.65 to 2.3	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = $0$ to $3.6\text{ V}$	1.65 to 2.3	2.3 to 2.7	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	1.65 to 2.3	0	—	2.0	$\mu\text{A}$	
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	1.65 to 2.3	Open	—	2.0	$\mu\text{A}$	
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.65 to 2.3	2.3 to 2.7	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.65 to 2.3	2.3 to 2.7	—	2.0	$\mu\text{A}$	
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	

### 12.1.6. $1.4\text{ V} \leq V_{CCA} < 1.65\text{ V}$ , $2.3\text{ V} \leq V_{CCB} \leq 2.7\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	1.4 to 1.65	2.3 to 2.7	$0.65 \times V_{CCA}$	—	V	
	$V_{IHB}$	Bn	1.4 to 1.65	2.3 to 2.7	1.6	—	V	
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	1.4 to 1.65	2.3 to 2.7	—	$0.30 \times V_{CCA}$	V	
	$V_{ILB}$	Bn	1.4 to 1.65	2.3 to 2.7	—	0.7	V	
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\ \mu\text{A}$	1.4 to 1.65	2.3 to 2.7	$V_{CCA} - 0.2$	—	V
			$I_{OHA} = -1\text{ mA}$	1.4	2.3 to 2.7	1.05	—	V
	$V_{OHB}$		$I_{OHB} = -100\ \mu\text{A}$	1.4 to 1.65	2.3 to 2.7	$V_{CCB} - 0.2$	—	V
			$I_{OHB} = -9\text{ mA}$	1.4 to 1.65	2.3	1.7	—	V
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\ \mu\text{A}$	1.4 to 1.65	2.3 to 2.7	—	0.2	V
			$I_{OLA} = 1\text{ mA}$	1.4	2.3 to 2.7	—	0.35	V
	$V_{OLB}$		$I_{OLB} = 100\ \mu\text{A}$	1.4 to 1.65	2.3 to 2.7	—	0.2	V
			$I_{OLB} = 9\text{ mA}$	1.4 to 1.65	2.3	—	0.6	V
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.4 to 1.65	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.4 to 1.65	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = $0$ to $3.6\text{ V}$	1.4 to 1.65	2.3 to 2.7	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	1.4 to 1.65	0	—	2.0	$\mu\text{A}$	
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	1.4 to 1.65	Open	—	2.0	$\mu\text{A}$	
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.4 to 1.65	2.3 to 2.7	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.4 to 1.65	2.3 to 2.7	—	2.0	$\mu\text{A}$	
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.4 to 1.65	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.4 to 1.65	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	

### 12.1.7. $1.1\text{ V} \leq V_{CCA} < 1.4\text{ V}$ , $2.3\text{ V} \leq V_{CCB} \leq 2.7\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	1.1 to 1.4	2.3 to 2.7	$0.65 \times V_{CCA}$	—	V	
	$V_{IHB}$	Bn	1.1 to 1.4	2.3 to 2.7	1.6	—	V	
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	1.1 to 1.4	2.3 to 2.7	—	$0.30 \times V_{CCA}$	V	
	$V_{ILB}$	Bn	1.1 to 1.4	2.3 to 2.7	—	0.7	V	
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\text{ }\mu\text{A}$	1.1 to 1.4	2.3 to 2.7	$V_{CCA} - 0.2$	—	V
	$V_{OHB}$		$I_{OHB} = -100\text{ }\mu\text{A}$	1.1 to 1.4	2.3 to 2.7	$V_{CCB} - 0.2$	—	V
	$V_{OHB}$		$I_{OHB} = -9\text{ mA}$	1.1 to 1.4	2.3	1.7	—	V
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\text{ }\mu\text{A}$	1.1 to 1.4	2.3 to 2.7	—	0.2	V
	$V_{OLB}$		$I_{OLB} = 100\text{ }\mu\text{A}$	1.1 to 1.4	2.3 to 2.7	—	0.2	V
	$V_{OLB}$		$I_{OLB} = 9\text{ mA}$	1.1 to 1.4	2.3	—	0.6	V
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0\text{ to }3.6\text{ V}$	1.1 to 1.4	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0\text{ to }3.6\text{ V}$	1.1 to 1.4	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = 0 to 3.6 V	1.1 to 1.4	2.3 to 2.7	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0\text{ to }3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	1.1 to 1.4	0	—	2.0	$\mu\text{A}$	
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0\text{ to }3.6\text{ V}$	1.1 to 1.4	Open	—	2.0	$\mu\text{A}$	
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.1 to 1.4	2.3 to 2.7	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.1 to 1.4	2.3 to 2.7	—	2.0	$\mu\text{A}$	
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.3 to 2.7	—	$\pm 2.0$	$\mu\text{A}$	

### 12.1.8. $1.1\text{ V} \leq V_{CCA} < 1.4\text{ V}$ , $1.65\text{ V} \leq V_{CCB} < 2.3\text{ V}$ (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Sym- bol	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IHA}$	DIR, $\overline{OE}$ , An	1.1 to 1.4	1.65 to 2.3	$0.65 \times V_{CCA}$	—	V	
	$V_{IHB}$	Bn	1.1 to 1.4	1.65 to 2.3	$0.65 \times V_{CCB}$	—		
Low-level input voltage	$V_{ILA}$	DIR, $\overline{OE}$ , An	1.1 to 1.4	1.65 to 2.3	—	$0.30 \times V_{CCA}$	V	
	$V_{ILB}$	Bn	1.1 to 1.4	1.65 to 2.3	—	$0.35 \times V_{CCB}$		
High-level output voltage	$V_{OHA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OHA} = -100\text{ }\mu\text{A}$	1.1 to 1.4	1.65 to 2.3	$V_{CCA} - 0.2$	—	V
	$V_{OHB}$		$I_{OHB} = -100\text{ }\mu\text{A}$	1.1 to 1.4	1.65 to 2.3	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -3\text{ mA}$	1.1 to 1.4	1.65	1.25	—	
Low-level output voltage	$V_{OLA}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLA} = 100\text{ }\mu\text{A}$	1.1 to 1.4	1.65 to 2.3	—	0.2	V
	$V_{OLB}$		$I_{OLB} = 100\text{ }\mu\text{A}$	1.1 to 1.4	1.65 to 2.3	—	0.2	
			$I_{OLB} = 3\text{ mA}$	1.1 to 1.4	1.65	—	0.3	
3-state output OFF-state leakage current	$I_{OZA}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.1 to 1.4	1.65 to 2.3	—	$\pm 2.0$	$\mu\text{A}$	
	$I_{OZB}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $3.6\text{ V}$	1.1 to 1.4	1.65 to 2.3	—	$\pm 2.0$		
Input leakage current	$I_{IN}$	$V_{IN}$ (DIR, $\overline{OE}$ ) = $0$ to $3.6\text{ V}$	1.1 to 1.4	1.65 to 2.3	—	$\pm 1.0$	$\mu\text{A}$	
Power-off leakage current	$I_{OFF1}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	0	0	—	2.0	$\mu\text{A}$	
	$I_{OFF2}$	$\overline{OE} = V_{CCA}$	1.1 to 1.4	0	—	2.0		
	$I_{OFF3}$	$V_{IN}, V_{OUT} = 0$ to $3.6\text{ V}$	1.1 to 1.4	Open	—	2.0		
Quiescent supply current	$I_{CCA}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.1 to 1.4	1.65 to 2.3	—	2.0	$\mu\text{A}$	
	$I_{CCB}$	$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND	1.1 to 1.4	1.65 to 2.3	—	2.0		
	$I_{CCA}$	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	1.65 to 2.3	—	$\pm 2.0$		
	$I_{CCB}$	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	1.65 to 2.3	—	$\pm 2.0$		

### 12.2. AC Characteristics

#### 12.2.1. $V_{CCA} = 2.5 \pm 0.2 \text{ V}$ , $V_{CCB} = 3.3 \pm 0.3 \text{ V}$ (Unless otherwise specified, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn → An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	5.4	ns
3-state output enable time ( $\overline{OE} \rightarrow An$ )	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	8.4	
3-state output disable time ( $\overline{OE} \rightarrow An$ )	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	6.7	
Propagation delay time (An → Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	6.8	ns
3-state output enable time ( $\overline{OE} \rightarrow Bn$ )	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	8.7	
3-state output disable time ( $\overline{OE} \rightarrow Bn$ )	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	3.9	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	0.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

#### 12.2.2. $V_{CCA} = 1.8 \pm 0.15 \text{ V}$ , $V_{CCB} = 3.3 \pm 0.3 \text{ V}$ (Unless otherwise specified, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn → An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	8.9	ns
3-state output enable time ( $\overline{OE} \rightarrow An$ )	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	13.4	
3-state output disable time ( $\overline{OE} \rightarrow An$ )	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	10.9	
Propagation delay time (An → Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	7.8	ns
3-state output enable time ( $\overline{OE} \rightarrow Bn$ )	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	10.7	
3-state output disable time ( $\overline{OE} \rightarrow Bn$ )	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	5.2	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	0.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

#### 12.2.3. $V_{CCA} = 1.5 \pm 0.1 \text{ V}$ , $V_{CCB} = 3.3 \pm 0.3 \text{ V}$ (Unless otherwise specified, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn → An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	10.3	ns
3-state output enable time ( $\overline{OE} \rightarrow An$ )	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	18.5	
3-state output disable time ( $\overline{OE} \rightarrow An$ )	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	13.0	
Propagation delay time (An → Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	8.6	ns
3-state output enable time ( $\overline{OE} \rightarrow Bn$ )	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	14.3	
3-state output disable time ( $\overline{OE} \rightarrow Bn$ )	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	6.6	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	1.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

### 12.2.4. $V_{CCA} = 1.2 \pm 0.1 \text{ V}$ , $V_{CCB} = 3.3 \pm 0.3 \text{ V}$ (Unless otherwise specified, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn $\rightarrow$ An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	61	ns
3-state output enable time ( $\overline{OE} \rightarrow$ An)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	95	
3-state output disable time ( $\overline{OE} \rightarrow$ An)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	44	
Propagation delay time (An $\rightarrow$ Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	22	ns
3-state output enable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	52	
3-state output disable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	18	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	1.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

### 12.2.5. $V_{CCA} = 1.8 \pm 0.15 \text{ V}$ , $V_{CCB} = 2.5 \pm 0.2 \text{ V}$ (Unless otherwise specified, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn $\rightarrow$ An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	9.1	ns
3-state output enable time ( $\overline{OE} \rightarrow$ An)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	13.5	
3-state output disable time ( $\overline{OE} \rightarrow$ An)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	11.8	
Propagation delay time (An $\rightarrow$ Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	9.5	ns
3-state output enable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	12.6	
3-state output disable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	5.1	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	0.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

### 12.2.6. $V_{CCA} = 1.5 \pm 0.1 \text{ V}$ , $V_{CCB} = 2.5 \pm 0.2 \text{ V}$ (Unless otherwise specified, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn $\rightarrow$ An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	10.8	ns
3-state output enable time ( $\overline{OE} \rightarrow$ An)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	18.3	
3-state output disable time ( $\overline{OE} \rightarrow$ An)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	14.2	
Propagation delay time (An $\rightarrow$ Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	10.5	ns
3-state output enable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	15.4	
3-state output disable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	6.4	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	1.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

### 12.2.7. $V_{CCA} = 1.2 \pm 0.1 \text{ V}$ , $V_{CCB} = 2.5 \pm 0.2 \text{ V}$ (Unless otherwise specified, $T_a = -40$ to $85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn $\rightarrow$ An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	60	ns
3-state output enable time ( $\overline{OE} \rightarrow$ An)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	95	
3-state output disable time ( $\overline{OE} \rightarrow$ An)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	45	
Propagation delay time (An $\rightarrow$ Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	23	ns
3-state output enable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	54	
3-state output disable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	17	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	1.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

### 12.2.8. $V_{CCA} = 1.2 \pm 0.1 \text{ V}$ , $V_{CCB} = 1.8 \pm 0.15 \text{ V}$ (Unless otherwise specified, $T_a = -40$ to $85 \text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0 \text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	Min	Max	Unit
Propagation delay time (Bn $\rightarrow$ An)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	58	ns
3-state output enable time ( $\overline{OE} \rightarrow$ An)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	92	
3-state output disable time ( $\overline{OE} \rightarrow$ An)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	47	
Propagation delay time (An $\rightarrow$ Bn)	$t_{PLH}/t_{PHL}$		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	30	ns
3-state output enable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PZL}/t_{PZH}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	55	
3-state output disable time ( $\overline{OE} \rightarrow$ Bn)	$t_{PLZ}/t_{PHZ}$		See Fig. 13.1, 14.2 Table 13.1.1, 13.1.2, 14.1.1	1.0	17	
Output skew	$t_{osLH}/t_{osHL}$	(Note 1)		—	1.5	ns

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

### 12.3. Dynamic Switching Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 2.0\text{ ns}$ , $C_L = 30\text{ pF}$ )

Characteristics		Symbol	Note	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Typ.	Unit
Quiet output maximum dynamic $V_{OL}$	A $\rightarrow$ B	$V_{OLP}$	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	0.8	V
					1.8	3.3	0.8	
					1.8	2.5	0.6	
	B $\rightarrow$ A				2.5	3.3	0.6	
					1.8	3.3	0.25	
					1.8	2.5	0.25	
Quiet output minimum dynamic $V_{OL}$	A $\rightarrow$ B	$V_{OLV}$	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	-0.8	V
					1.8	3.3	-0.8	
					1.8	2.5	-0.6	
	B $\rightarrow$ A				2.5	3.3	-0.6	
					1.8	3.3	-0.25	
					1.8	2.5	-0.25	
Quiet output maximum dynamic $V_{OH}$	A $\rightarrow$ B	$V_{OHP}$	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	4.6	V
					1.8	3.3	4.6	
					1.8	2.5	3.3	
	B $\rightarrow$ A				2.5	3.3	3.3	
					1.8	3.3	2.3	
					1.8	2.5	2.3	
Quiet output minimum dynamic $V_{OH}$	A $\rightarrow$ B	$V_{OHV}$	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	2.0	V
					1.8	3.3	2.0	
					1.8	2.5	1.7	
	B $\rightarrow$ A				2.5	3.3	1.7	
					1.8	3.3	1.3	
					1.8	2.5	1.3	

Note 1: Parameter guaranteed by design.

### 12.4. Capacitive Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Note	Test Condition	$V_{CCA}$ (V)	$V_{CCB}$ (V)	Typ.	Unit	
Input capacitance	$C_{IN}$		DIR, $\overline{OE}$	2.5	3.3	7	pF	
Bus I/O capacitance	$C_{I/O}$		An, Bn	2.5	3.3	8	pF	
Power dissipation capacitance	$C_{PDA}$	(Note 1)	$\overline{OE} = L$	A $\rightarrow$ B (DIR = H)	2.5	3.3	3	pF
				B $\rightarrow$ A (DIR = L)	2.5	3.3	16	
			$\overline{OE} = H$	A $\rightarrow$ B (DIR = H)	2.5	3.3	0	
				B $\rightarrow$ A (DIR = L)	2.5	3.3	0	
	$C_{PDB}$	(Note 1)	$\overline{OE} = L$	A $\rightarrow$ B (DIR = H)	2.5	3.3	16	
				B $\rightarrow$ A (DIR = L)	2.5	3.3	5	
			$\overline{OE} = H$	A $\rightarrow$ B (DIR = H)	2.5	3.3	0	
				B $\rightarrow$ A (DIR = L)	2.5	3.3	0	

Note 1:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4 \text{ (per bit)}$$

### 13. AC Test Circuit

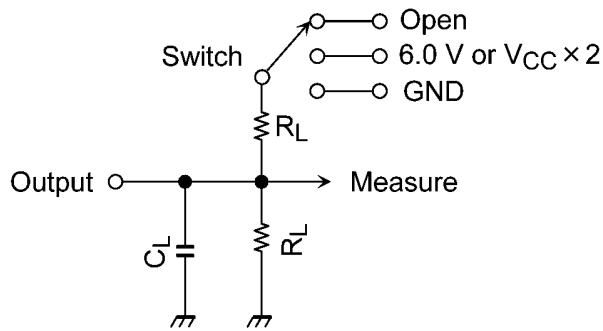


Fig. 13.1 AC Test Circuit

Table 13.1.1 Parameter for AC Test Circuit

Parameter	Switch	Test Condition
$t_{PLH}$ , $t_{PHL}$	Open	—
$t_{PLZ}$ , $t_{PZL}$	6.0 V	$V_{CC} = 3.3 \pm 0.3 \text{ V}$
	$V_{CC} \times 2$	$V_{CC} = 2.5 \pm 0.2 \text{ V}$
		$V_{CC} = 1.8 \pm 0.15 \text{ V}$
		$V_{CC} = 1.5 \pm 0.1 \text{ V}$
		$V_{CC} = 1.2 \pm 0.1 \text{ V}$
$t_{PHZ}$ , $t_{PZH}$	GND	—

Table 13.1.2 Parameter for AC Test Circuit

Symbol	$V_{CC} = 3.3 \pm 0.3 \text{ V}$ $V_{CC} = 2.5 \pm 0.2 \text{ V}$	$V_{CC} = 1.8 \pm 0.15 \text{ V}$	$V_{CC} = 1.5 \pm 0.1 \text{ V}$	$V_{CC} = 1.2 \pm 0.1 \text{ V}$
$R_L$	500 $\Omega$	1 k $\Omega$	2 k $\Omega$	10 k $\Omega$
$C_L$	30 pF	30 pF	15 pF	15 pF

### 14. AC Waveform

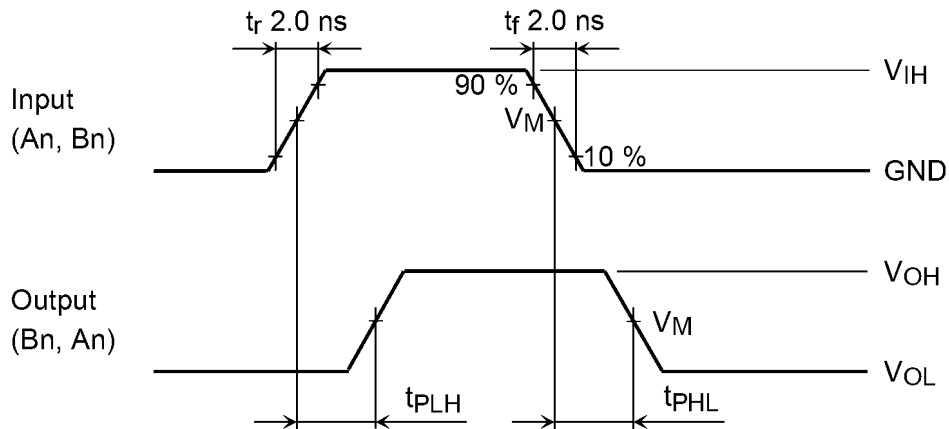


Fig. 14.1  $t_{PLH}$ ,  $t_{PHL}$

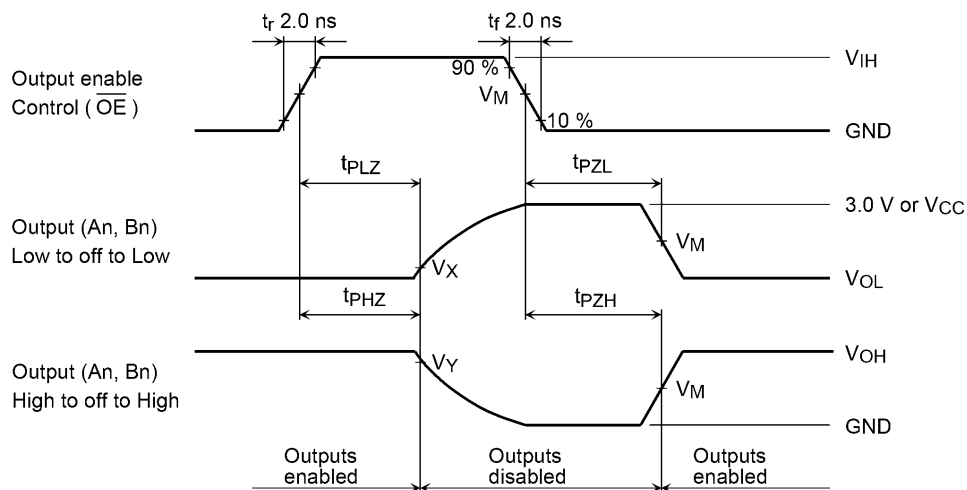


Fig. 14.2  $t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$

Table 14.1.1 AC Waveform Symbols

Symbol	$V_{CC} = 3.3 \pm 0.3 \text{ V}$	$V_{CC} = 2.5 \pm 0.2 \text{ V}$ $V_{CC} = 1.8 \pm 0.15 \text{ V}$	$V_{CC} = 1.5 \pm 0.1 \text{ V}$ $V_{CC} = 1.2 \pm 0.1 \text{ V}$
$V_{IH}$	2.7 V	$V_{CC}$	$V_{CC}$
$V_M$	1.5 V	$V_{CC}/2$	$V_{CC}/2$
$V_X$	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.1 \text{ V}$
$V_Y$	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.1 \text{ V}$



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