

TC7MPN3125FK

1. Functional Description

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

2. General

The TC7MPN3125FK 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)

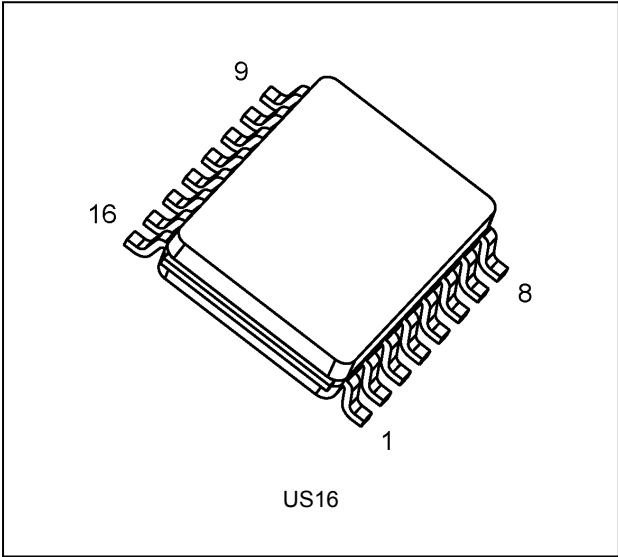
- Operating voltage: 1.2 V and 1.8 V / 1.2 V and 2.5 V / 1.2 V and 3.3 V / 1.5 V and 2.5 V / 1.5 V and 3.3 V / 1.8 V and 2.5 V / 1.8 V and 3.3 V / 2.5 V and 3.3 V
bidirectional interface
- High-speed operation: $t_{pd} = 13.7$ ns (max) ($V_{CCA} = 2.5 \pm 0.2$ V, $V_{CCB} = 3.3 \pm 0.3$ V)
 $t_{pd} = 14.8$ ns (max) ($V_{CCA} = 1.8 \pm 0.15$ V, $V_{CCB} = 3.3 \pm 0.3$ V)
 $t_{pd} = 16.0$ 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)
 $t_{pd} = 18.5$ ns (max) ($V_{CCA} = 1.8 \pm 0.15$ V, $V_{CCB} = 2.5 \pm 0.2$ V)
 $t_{pd} = 19.7$ 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: $|I_{OHB}|/I_{OLB} = 3$ mA (min) ($V_{CCB} = 3.0$ V)
 $|I_{OHB}|/I_{OLB} = 2$ mA (min) ($V_{CCB} = 2.3$ V)
 $|I_{OHB}|/I_{OLB} = 0.5$ mA (min) ($V_{CCB} = 1.65$ V)
 $|I_{OHA}|/I_{OLA} = 9$ mA (min) ($V_{CCA} = 2.3$ V)
 $|I_{OHA}|/I_{OLA} = 3$ mA (min) ($V_{CCA} = 1.65$ V)
 $|I_{OHA}|/I_{OLA} = 1$ mA (min) ($V_{CCA} = 1.4$ V)
- Latch-up performance: $\geq \pm 300$ mA
- ESD performance: MM $\geq \pm 200$ V, HBM $\geq \pm 2000$ 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.

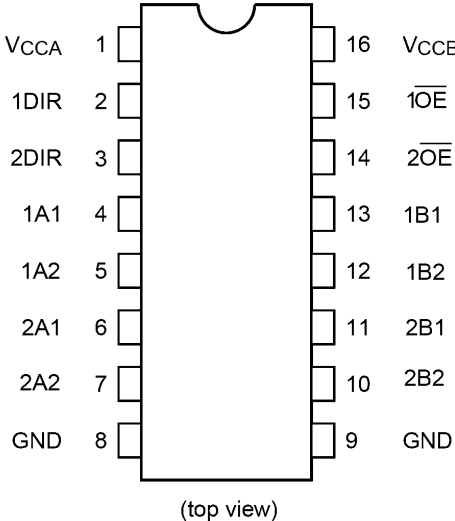
Start of commercial production

2019-03

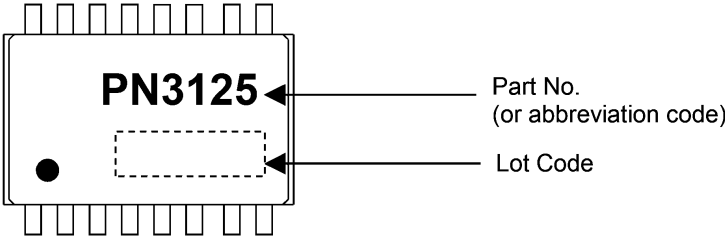
4. Packaging



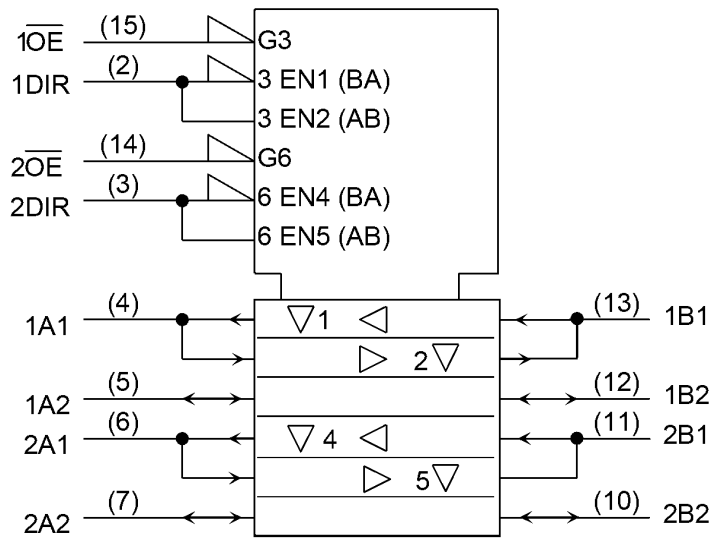
5. Pin Assignment



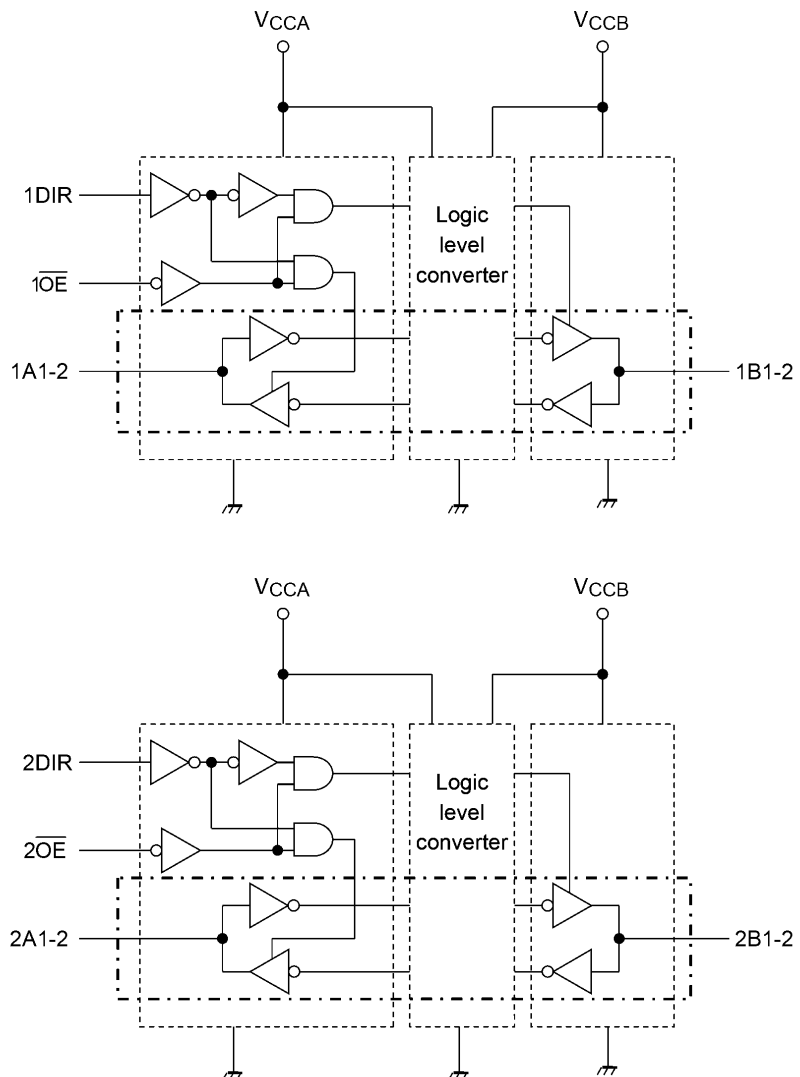
6. Marking



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)	± 50	mA
Output current	I_{OUTA}		± 25	mA
	I_{OUTB}		± 6	
V_{CC} /ground current per supply pin	I_{CCA}		± 50	mA
	I_{CCB}		± 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	± 9	mA
			$V_{CCA} = 1.65$ to 1.95 V	± 3	
			$V_{CCA} = 1.4$ to 1.6 V	± 1	
	I_{OUTB}		$V_{CCB} = 3.0$ to 3.6 V	± 3	
			$V_{CCB} = 2.3$ to 2.7 V	± 2	
			$V_{CCB} = 1.65$ to 1.95 V	± 0.5	
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	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -3\text{ mA}$	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	
			$I_{OLB} = 3\text{ mA}$	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 V	2.3 to 2.7	2.7 to 3.6	—	± 2.0	μA	
	I_{OZB}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 3.6 V	2.3 to 2.7	2.7 to 3.6	—	± 2.0		
Input leakage current	I_{IN}	V_{IN} (DIR, \overline{OE}) = 0 to 3.6 V	2.3 to 2.7	2.7 to 3.6	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	0	—	2.0	μA	
	I_{OFF2}	$\overline{OE} = V_{CCA}$	2.3 to 2.7	0	—	2.0		
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 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	μA	
	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	—	± 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	—	± 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	Sym- bol	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
			$I_{OHB} = -3\text{ mA}$	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
			$I_{OLB} = 3\text{ mA}$	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 V	1.65 to 2.3	2.7 to 3.6	—	± 2.0	μA	
	I_{OZB}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 3.6 V	1.65 to 2.3	2.7 to 3.6	—	± 2.0	μA	
Input leakage current	I_{IN}	V_{IN} (DIR, \overline{OE}) = 0 to 3.6 V	1.65 to 2.3	2.7 to 3.6	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	0	—	2.0	μA	
	I_{OFF2}	$\overline{OE} = V_{CCA}$	1.65 to 2.3	0	—	2.0	μA	
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	1.65 to 2.3	Open	—	2.0	μA	
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	μA	
	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	μA	
	I_{CCA}	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.7 to 3.6	—	± 2.0	μA	
	I_{CCB}	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.7 to 3.6	—	± 2.0	μA	
	I_{CCTB}	$V_{INB} = V_{CCB} - 0.6\text{ V}$ per input	1.65 to 2.3	2.7 to 3.6	—	750.0	μA	

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	Sym- bol	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}	$I_{OHA} = -100\text{ }\mu\text{A}$	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}		$I_{OHB} = -100\text{ }\mu\text{A}$	1.4 to 1.65	2.7 to 3.6	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -3\text{ mA}$	1.4 to 1.65	3.0	2.2	—	
Low-level output voltage	V_{OLA}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OLA} = 100\text{ }\mu\text{A}$	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}		$I_{OLB} = 100\text{ }\mu\text{A}$	1.4 to 1.65	2.7 to 3.6	—	0.2	
			$I_{OLB} = 3\text{ mA}$	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 V	1.4 to 1.65	2.7 to 3.6	—	± 2.0	μA	
	I_{OZB}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 3.6 V	1.4 to 1.65	2.7 to 3.6	—	± 2.0		
Input leakage current	I_{IN}	V_{IN} (DIR, \overline{OE}) = 0 to 3.6 V	1.4 to 1.65	2.7 to 3.6	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	0	—	2.0	μA	
	I_{OFF2}	$\overline{OE} = V_{CCA}$	1.4 to 1.65	0	—	2.0		
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 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	μA	
	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	—	± 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	—	± 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	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	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}	$I_{OHA} = -100\ \mu\text{A}$	1.1 to 1.4	2.7 to 3.6	$V_{CCA} - 0.2$	—	V
	V_{OHB}		$I_{OHB} = -100\ \mu\text{A}$	1.1 to 1.4	2.7 to 3.6	$V_{CCB} - 0.2$	—	V
	V_{OHB}		$I_{OHB} = -3\ \text{mA}$	1.1 to 1.4	3.0	2.2	—	V
Low-level output voltage	V_{OLA}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OLA} = 100\ \mu\text{A}$	1.1 to 1.4	2.7 to 3.6	—	0.2	V
	V_{OLB}		$I_{OLB} = 100\ \mu\text{A}$	1.1 to 1.4	2.7 to 3.6	—	0.2	V
	V_{OLB}		$I_{OLB} = 3\ \text{mA}$	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 V	1.1 to 1.4	2.7 to 3.6	—	± 2.0	μA	
	I_{OZB}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 3.6 V	1.1 to 1.4	2.7 to 3.6	—	± 2.0	μA	
Input leakage current	I_{IN}	V_{IN} (DIR, \overline{OE}) = 0 to 3.6 V	1.1 to 1.4	2.7 to 3.6	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	0	—	2.0	μA	
	I_{OFF2}	$\overline{OE} = V_{CCA}$	1.1 to 1.4	0	—	2.0	μA	
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	1.1 to 1.4	Open	—	2.0	μA	
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	μA	
	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	μA	
	I_{CCA}	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.7 to 3.6	—	± 2.0	μA	
	I_{CCB}	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.7 to 3.6	—	± 2.0	μA	
	I_{CCTB}	$V_{INB} = V_{CCB} - 0.6\text{ V}$ per input	1.1 to 1.4	2.7 to 3.6	—	750.0	μA	

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	Sym- bol	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
			$I_{OHB} = -2\text{ mA}$	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
			$I_{OLB} = 2\text{ mA}$	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 V	1.65 to 2.3	2.3 to 2.7	—	± 2.0	μA	
	I_{OZB}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 3.6 V	1.65 to 2.3	2.3 to 2.7	—	± 2.0	μA	
Input leakage current	I_{IN}	V_{IN} (DIR, \overline{OE}) = 0 to 3.6 V	1.65 to 2.3	2.3 to 2.7	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	0	—	2.0	μA	
	I_{OFF2}	$\overline{OE} = V_{CCA}$	1.65 to 2.3	0	—	2.0	μA	
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	1.65 to 2.3	Open	—	2.0	μA	
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	μA	
	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	μA	
	I_{CCA}	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.3 to 2.7	—	± 2.0	μA	
	I_{CCB}	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.65 to 2.3	2.3 to 2.7	—	± 2.0	μA	

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, $T_a = -40$ 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	1.4 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}	$I_{OHA} = -100\text{ }\mu\text{A}$	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}		$I_{OHB} = -100\text{ }\mu\text{A}$	1.4 to 1.65	2.3 to 2.7	$V_{CCB} - 0.2$	—	V
			$I_{OHB} = -2\text{ mA}$	1.4 to 1.65	2.3	1.7	—	V
Low-level output voltage	V_{OLA}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OLA} = 100\text{ }\mu\text{A}$	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}		$I_{OLB} = 100\text{ }\mu\text{A}$	1.4 to 1.65	2.3 to 2.7	—	0.2	V
			$I_{OLB} = 2\text{ mA}$	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 V	1.4 to 1.65	2.3 to 2.7	—	± 2.0	μA	
	I_{OZB}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 3.6 V	1.4 to 1.65	2.3 to 2.7	—	± 2.0	μA	
Input leakage current	I_{IN}	V_{IN} (DIR, \overline{OE}) = 0 to 3.6 V	1.4 to 1.65	2.3 to 2.7	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	0	—	2.0	μA	
	I_{OFF2}	$\overline{OE} = V_{CCA}$	1.4 to 1.65	0	—	2.0	μA	
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	1.4 to 1.65	Open	—	2.0	μA	
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	μA	
	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	μA	
	I_{CCA}	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.4 to 1.65	2.3 to 2.7	—	± 2.0	μA	
	I_{CCB}	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.4 to 1.65	2.3 to 2.7	—	± 2.0	μA	

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, $T_a = -40$ 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	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}		$I_{OHB} = -2\text{ mA}$	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}		$I_{OLB} = 2\text{ mA}$	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} $V_{OUT} = 0$ to 3.6 V	1.1 to 1.4	2.3 to 2.7	—	± 2.0	μA	
	I_{OZB}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 3.6 V	1.1 to 1.4	2.3 to 2.7	—	± 2.0	μA	
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	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	0	—	2.0	μA	
	I_{OFF2}	$\overline{OE} = V_{CCA}$	1.1 to 1.4	0	—	2.0	μA	
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	1.1 to 1.4	Open	—	2.0	μA	
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	μA	
	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	μA	
	I_{CCA}	$V_{CCA} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.3 to 2.7	—	± 2.0	μA	
	I_{CCB}	$V_{CCB} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.1 to 1.4	2.3 to 2.7	—	± 2.0	μA	

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}	$I_{OHA} = -100\ \mu\text{A}$	1.1 to 1.4	1.65 to 2.3	$V_{CCA} - 0.2$	—	V
	V_{OHB}		$I_{OHB} = -100\ \mu\text{A}$	1.1 to 1.4	1.65 to 2.3	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -0.5\ \text{mA}$	1.1 to 1.4	1.65	1.25	—	
Low-level output voltage	V_{OLA}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OLA} = 100\ \mu\text{A}$	1.1 to 1.4	1.65 to 2.3	—	0.2	V
	V_{OLB}		$I_{OLB} = 100\ \mu\text{A}$	1.1 to 1.4	1.65 to 2.3	—	0.2	
			$I_{OLB} = 0.5\ \text{mA}$	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	—	± 2.0	μA	
	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	—	± 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	—	± 1.0	μA	
Power-off leakage current	I_{OFF1}	$V_{IN}, V_{OUT} = 0$ to $3.6\ \text{V}$	0	0	—	2.0	μA	
	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	μA	
	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	—	± 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	—	± 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 \rightarrow 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 \rightarrow Bn)	t_{PLH}/t_{PHL}		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	13.7	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	16.6	
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	7.2	
Output skew	t_{osLH}/t_{osHL}	(Note 1)		—	0.5	ns

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

12.2.2. $V_{CCA} = 1.8 \pm 0.15 \text{ V}$, $V_{CCB} = 3.3 \pm 0.3 \text{ V}$ (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 \rightarrow 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 \rightarrow Bn)	t_{PLH}/t_{PHL}		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	14.8	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	18.9	
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	8.7	
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 \rightarrow An)	t_{PLH}/t_{PHL}		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	10.3	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 \rightarrow Bn)	t_{PLH}/t_{PHL}		See Fig. 13.1, 14.1 Table 13.1.1, 13.1.2, 14.1.1	1.0	16.0	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	22.8	
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	10.2	
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, $T_a = -40$ 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	29	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	63	
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	23	
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, $T_a = -40$ 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	18.5	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	23.6	
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	6.9	
Output skew	t_{osLH}/t_{osHL}	(Note 1)		—	0.5	ns

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

12.2.6. $V_{CCA} = 1.5 \pm 0.1 \text{ V}$, $V_{CCB} = 2.5 \pm 0.2 \text{ V}$ (Unless otherwise specified, $T_a = -40$ 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	19.7	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	26.6	
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	8.3	
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, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, 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	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	33	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	66	
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	20	
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, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, 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	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	43	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	78	
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	20	
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 → B	V_{OLP}	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	0.35	V
					1.8	3.3	0.35	
					1.8	2.5	0.25	
	B → 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 → B	V_{OLV}	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	-0.35	V
					1.8	3.3	-0.35	
					1.8	2.5	-0.25	
	B → 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 → B	V_{OHP}	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	3.95	V
					1.8	3.3	3.95	
					1.8	2.5	2.95	
	B → 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 → B	V_{OHV}	(Note 1)	$V_{IH} = V_{CC}, V_{IL} = 0\text{ V}$	2.5	3.3	2.65	V
					1.8	3.3	2.65	
					1.8	2.5	2.05	
	B → 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 → B (DIR = H)	2.5	3.3	3	pF
				B → A (DIR = L)	2.5	3.3	16	
			$\overline{OE} = H$	A → B (DIR = H)	2.5	3.3	0	
				B → A (DIR = L)	2.5	3.3	0	
	C_{PDB}	(Note 1)	$\overline{OE} = L$	A → B (DIR = H)	2.5	3.3	16	
				B → A (DIR = L)	2.5	3.3	5	
			$\overline{OE} = H$	A → B (DIR = H)	2.5	3.3	0	
				B → 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

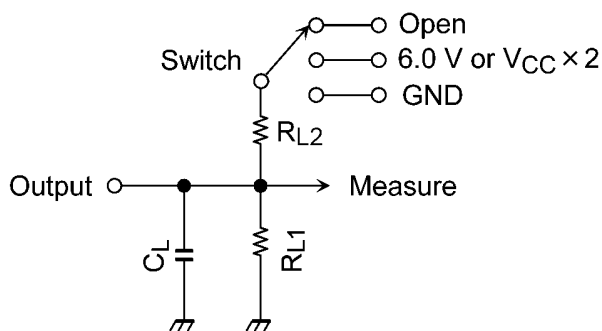


Fig. 13.1 AC Test Circuit

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	$V_{CC} = 3.3 \pm 0.3 \text{ V}$ $V_{CC} = 2.5 \pm 0.2 \text{ V}$	$V_{CC} = 1.8 \pm 0.15 \text{ V}$	$V_{CC} = 1.5 \pm 0.1 \text{ V}$	$V_{CC} = 1.2 \pm 0.1 \text{ V}$
$R_{L1/2A}$	500 Ω	1 k Ω	2 k Ω	10 k Ω
C_{LA}	30 pF	30 pF	15 pF	15 pF
R_{L1B}	—	—	—	—
R_{L2B}	1 k Ω	1 k Ω	1 k Ω	1 k Ω
C_{LB}	30 pF	30 pF	30 pF	30 pF

14. AC Waveform

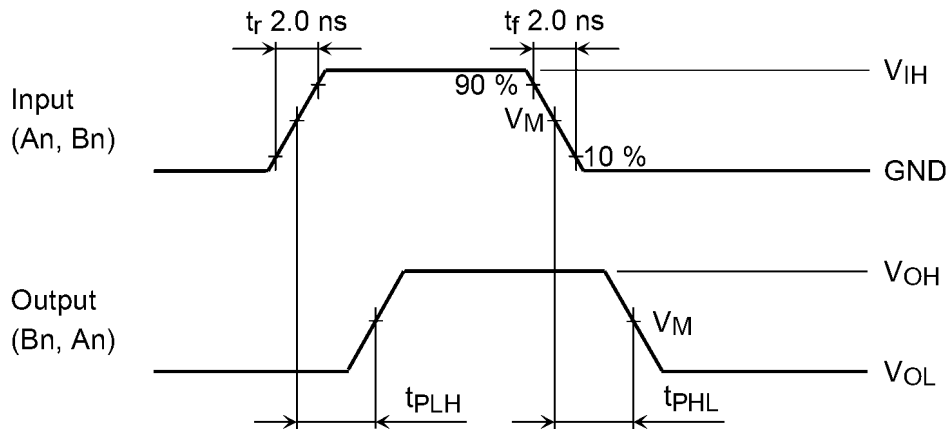


Fig. 14.1 t_{PLH} , t_{PHL}

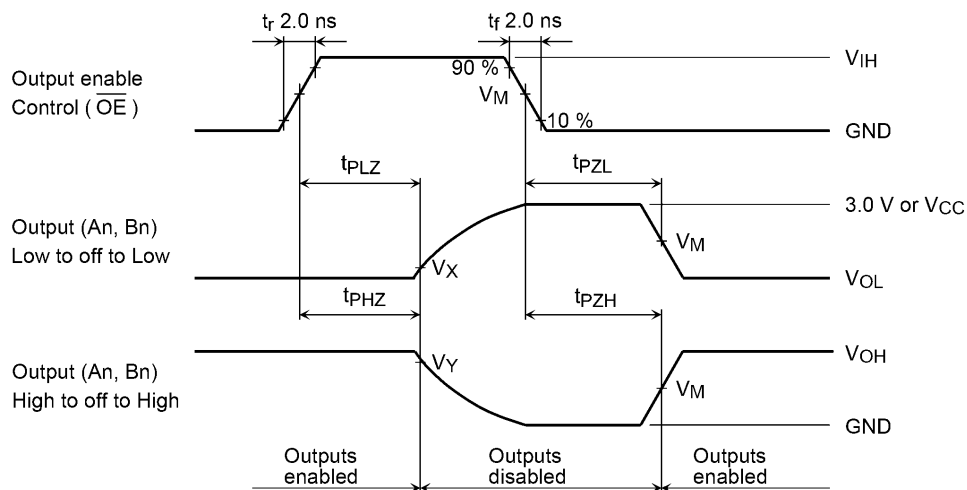


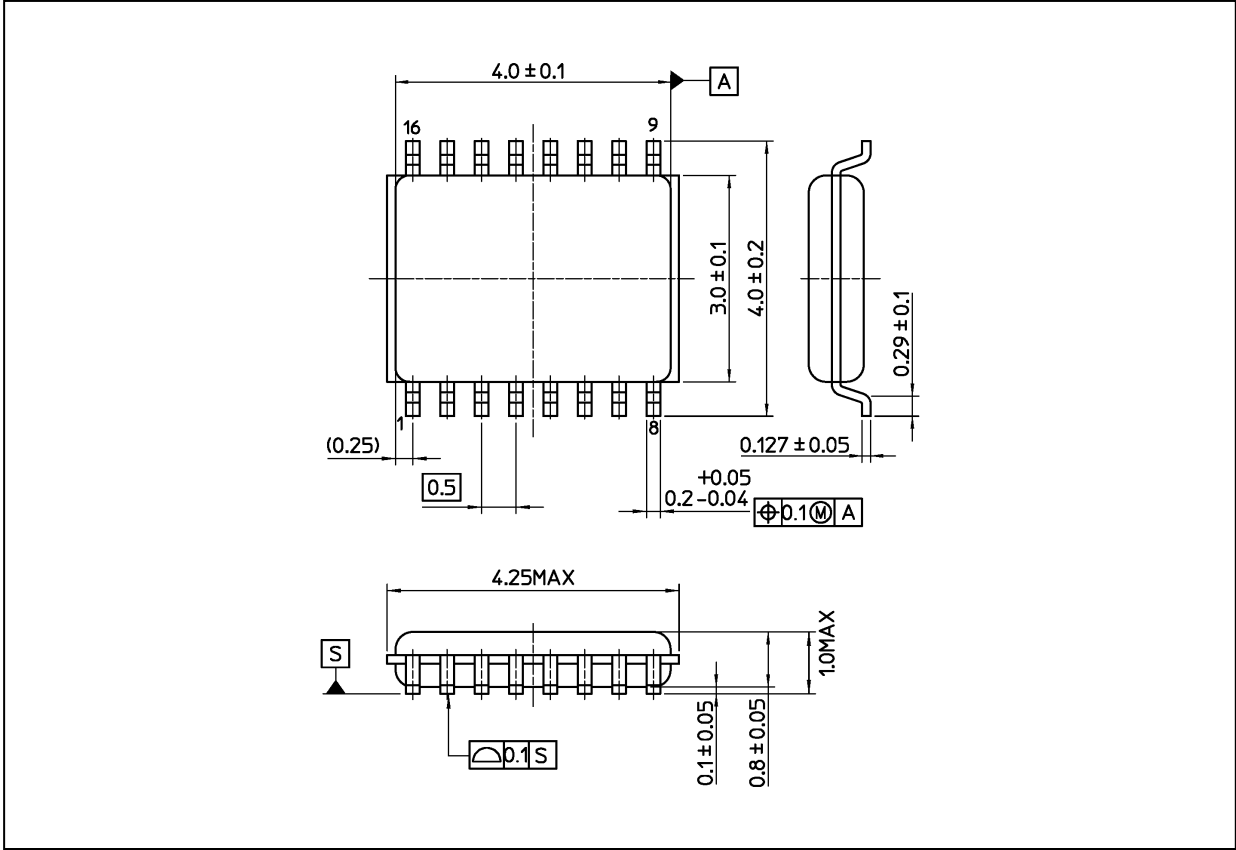
Fig. 14.2 t_{PLZ} , t_{PHZ} , t_{PZL} , t_{PZH}

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	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.1 \text{ V}$

Package Dimensions

Unit: mm



Weight: 0.02 g (typ.)

Package Name(s)
Nickname: US16

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