

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).

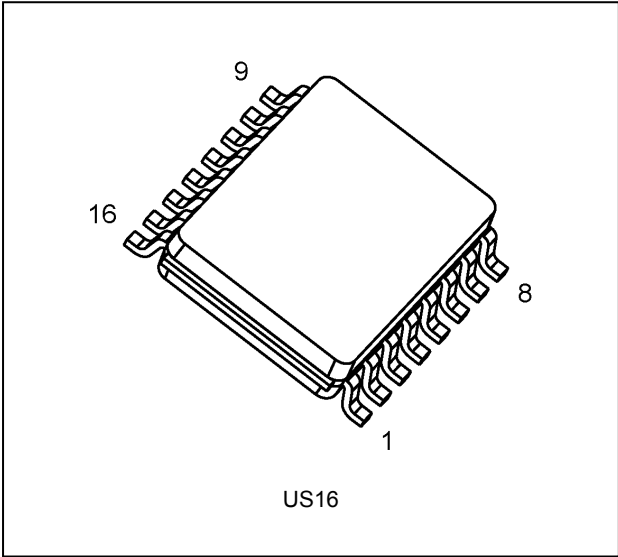
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

3. Features (Note)

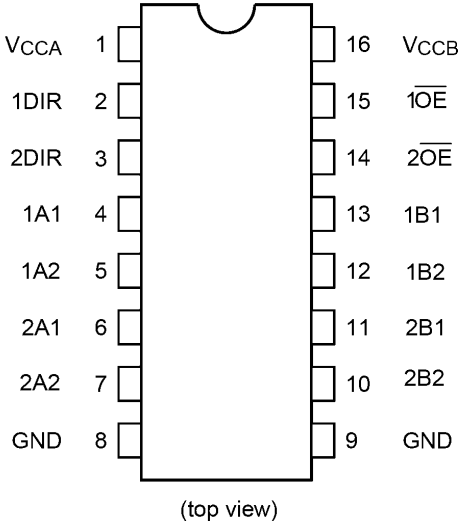
- Operating voltage: 1.2 V and 1.8 V / 1.2 V and 2.5 V / 1.2 V and 3.3 V / 1.5 V and 2.5 V / 1.5 V and 3.3 V / 1.8 V and 2.5 V / 1.8 V and 3.3 V / 2.5 V and 3.3 V
bidirectional interface
- High-speed operation: $t_{pd} = 13.7$ ns (max) ($V_{CCA} = 2.5 \pm 0.2$ V, $V_{CCB} = 3.3 \pm 0.3$ V)
 $t_{pd} = 14.8$ 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)
- 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.

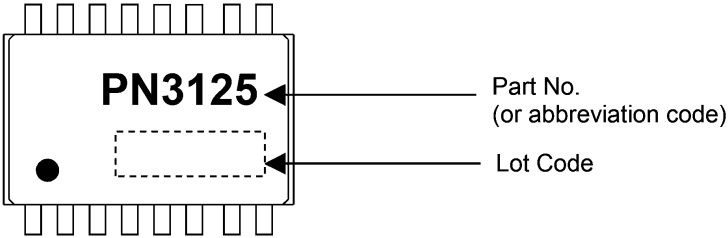
4. Packaging



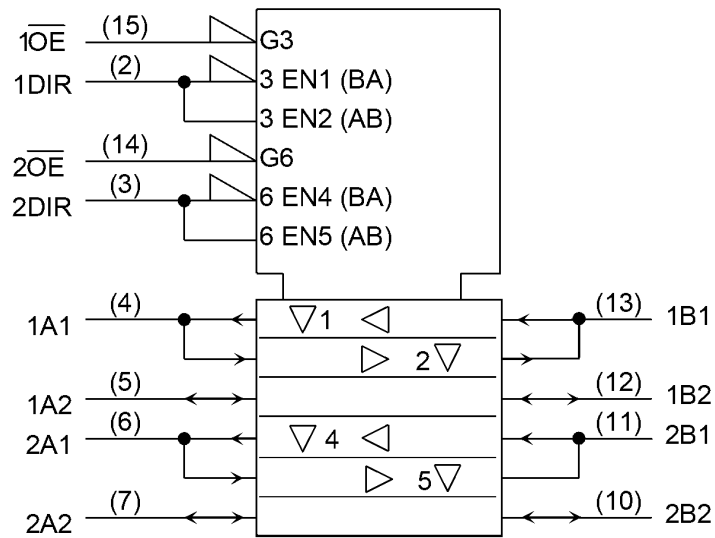
5. Pin Assignment



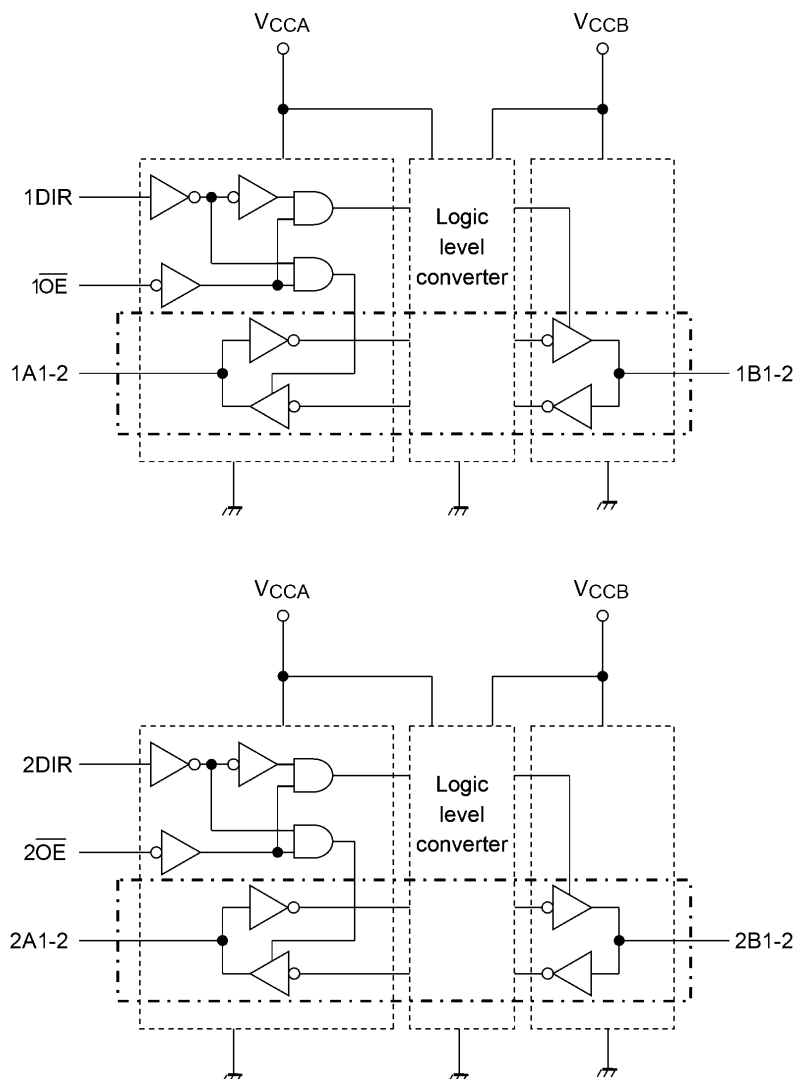
6. Marking



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)	± 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	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	—		
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		
High-level output voltage	V_{OHA}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OHA} = -100\ \mu\text{A}$	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_{OHB}		$I_{OHB} = -100\ \mu\text{A}$	1.65 to 2.3	2.7 to 3.6	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -3\text{ mA}$	1.65 to 2.3	3.0	2.2	—	
Low-level output voltage	V_{OLA}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OLA} = 100\ \mu\text{A}$	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_{OLB}		$I_{OLB} = 100\ \mu\text{A}$	1.65 to 2.3	2.7 to 3.6	—	0.2	
			$I_{OLB} = 3\text{ mA}$	1.65 to 2.3	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	1.65 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		
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		
	I_{OFF3}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	1.65 to 2.3	Open	—	2.0		
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		
	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		
	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		
	I_{CCTB}	$V_{INB} = V_{CCB} - 0.6\text{ V}$ per input	1.65 to 2.3	2.7 to 3.6	—	750.0		

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}	$I_{OHA} = -100\text{ }\mu\text{A}$	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	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}		$I_{OHB} = -3\text{ mA}$	1.1 to 1.4	3.0	2.2	—	V
Low-level output voltage	V_{OLA}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OLA} = 100\text{ }\mu\text{A}$	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}		$I_{OLB} = 3\text{ mA}$	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	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
			$I_{OHB} = -2\text{ mA}$	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, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$)

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	—		
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		
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_{OHB}		$I_{OHB} = -100\text{ }\mu\text{A}$	1.4 to 1.65	2.3 to 2.7	$V_{CCB} - 0.2$	—	
			$I_{OHB} = -2\text{ mA}$	1.4 to 1.65	2.3	1.7	—	
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_{OLB}		$I_{OLB} = 100\text{ }\mu\text{A}$	1.4 to 1.65	2.3 to 2.7	—	0.2	
			$I_{OLB} = 2\text{ mA}$	1.4 to 1.65	2.3	—	0.6	
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		
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		
	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	2.3 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		
	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		
	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		

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}		$I_{OHB} = -2\text{ mA}$	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, $T_a = -40$ 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, $T_a = -40$ 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, $T_a = -40$ 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, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, 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	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 → 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, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, 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	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 → 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, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, 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	10.8	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 → 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

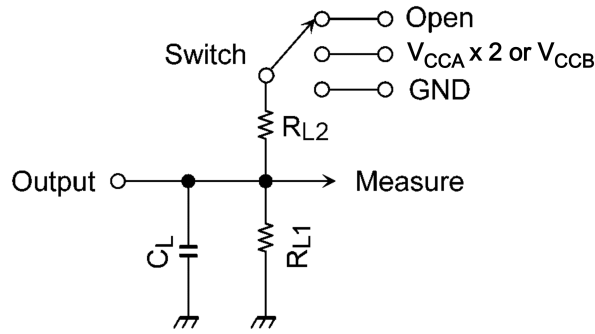


Fig. 13.1 AC Test Circuit

Table 13.1.1 Parameter for AC Test Circuit

Parameter	Switch Output A	Switch Output B
t_{PLH} , t_{PHL}	Open	Open
t_{PLZ} , t_{PZL}	$V_{CCA} \times 2$	V_{CCB}
t_{PHZ} , t_{PZH}	GND	GND

Table 13.1.2 Parameter for AC Test Circuit

Symbol	$V_{CCB} = 3.3 \pm 0.3 \text{ V}$ $V_{CCB} = 2.5 \pm 0.2 \text{ V}$ $V_{CCA} = 2.5 \pm 0.2 \text{ V}$	$V_{CCB} = 1.8 \pm 0.15 \text{ V}$ $V_{CCA} = 1.8 \pm 0.15 \text{ V}$	$V_{CCA} = 1.5 \pm 0.1 \text{ V}$	$V_{CCA} = 1.2 \pm 0.1 \text{ V}$
R_{L1A}	500 Ω	1 k Ω	2 k Ω	10 k Ω
R_{L2A}	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	—	—
C_{LB}	30 pF	30 pF	—	—

14. AC Waveform

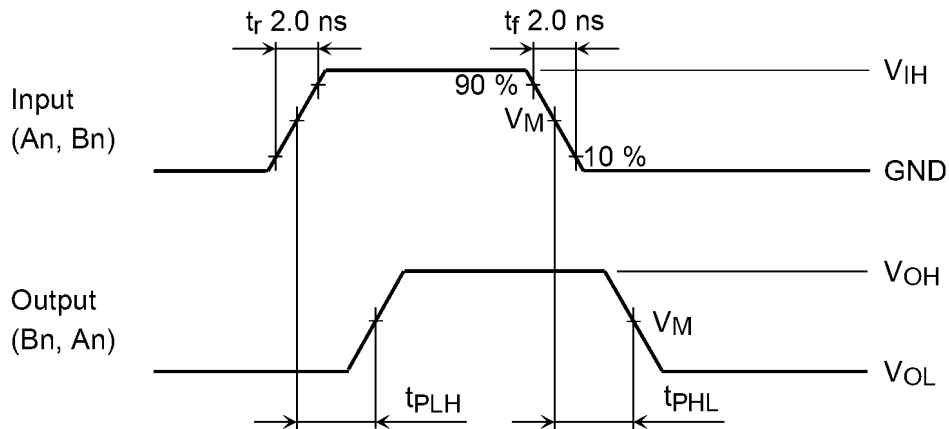


Fig. 14.1 t_{PLH} , t_{PHL}

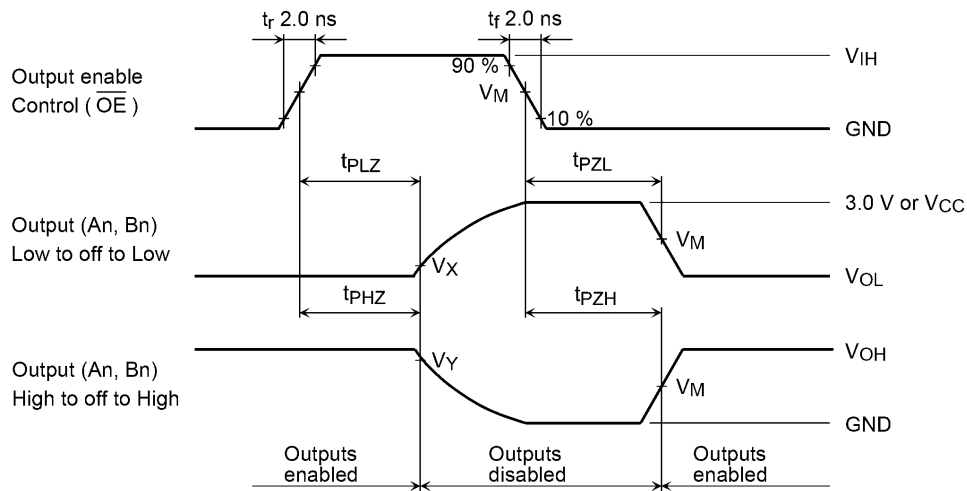


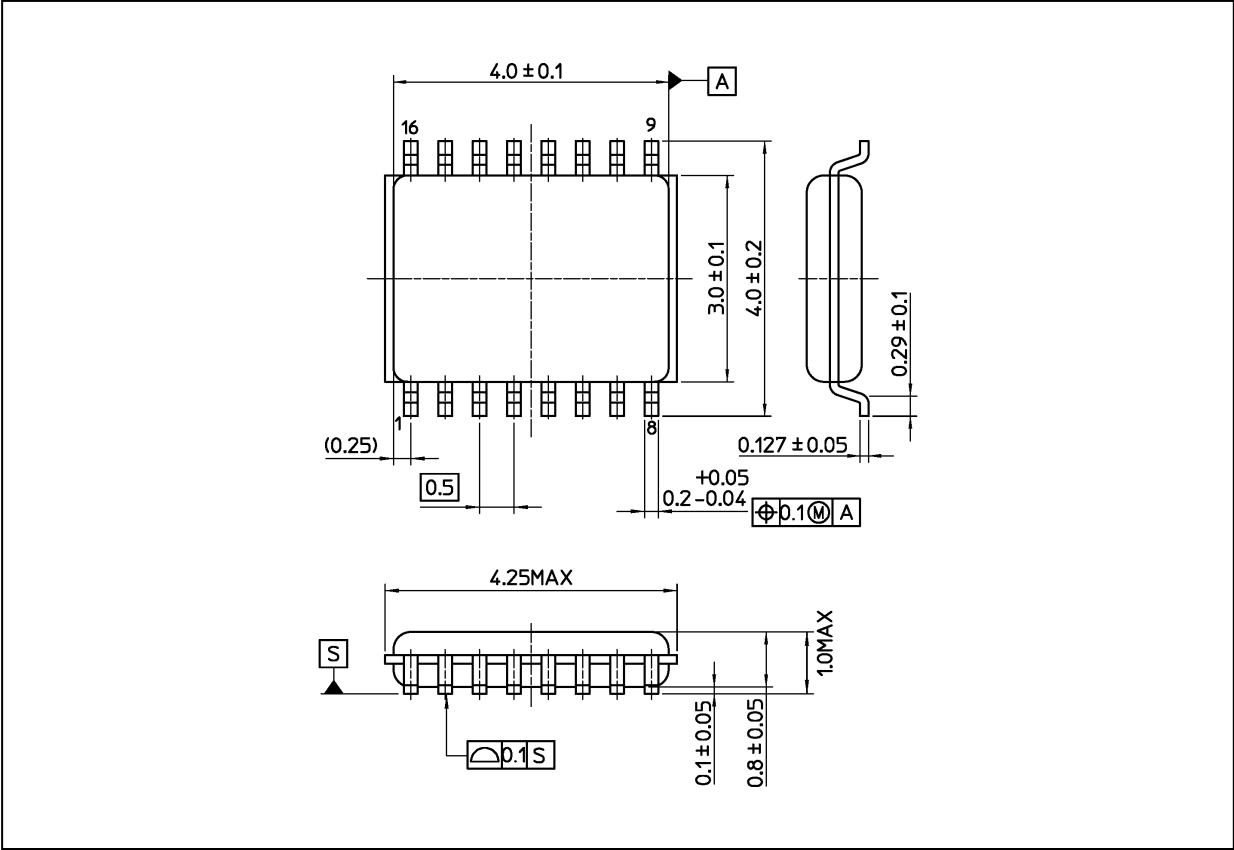
Fig. 14.2 t_{PLZ} , t_{PHZ} , t_{PZL} , t_{PZH}

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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