CMOS Digital Integrated Circuits Silicon Monolithic

74LVC2T45FK

1. Functional Description

- 2-Bit Dual Supply Bus Transceiver

2. General

74LVC2T45FK is a dual power supply type high-speed CMOS 2-bit bus transceiver that enables interfacing between two systems with power supply voltages from 1.65 V to 5.5 V.

The voltage of the two supply voltages can be set as desired by the user within the operating range, and the order in which the supply voltages are turned on and off can also be freely set.

When the transmission direction switching input DIR is set to "H", the A bus becomes input and the B bus becomes output, and when DIR is set to "L", the B bus becomes input and the A bus becomes output. The input (DIR) allows a voltage of up to 5.5 V to be applied regardless of the power supply voltage by the tolerant function. The power-down protection function of the bus terminals (nA, nB) allows a voltage of up to 5.5 V to be applied when the power supply is at GND level. Also, when the power supply is at GND level, the bus terminals become high impedance mode and a voltage of up to 5.5 V can be applied. This function enables application to partial power-down interfaces.

All inputs have protection circuits added to protect the device from electrostatic breakdown.

3. Features

(1) Wide operating temperature range: T_{opr} = -40 to 125 °C

(2) Operating power supply voltage:
1.8 V and 2.5 V / 1.8 V and 3.3 V / 1.8 V and 5.0 V / 2.5 V and 3.3 V / 2.5 V and 5.0 V / 3.3 V and 5.0 V bidirectional interface

(3) Propagation delay time: t_{pd} = 5.0 ns (max) (T_a = 25 °C) (V_{CCA} = 3.0 V, V_{CCB} = 4.5 V)

(4) Output current: $|I_{OH}|/I_{OL}$ = 32 mA (min) (V_{CC} = 4.5 V)
$|I_{OH}|/I_{OL}$ = 24 mA (min) (V_{CC} = 3.0 V)
$|I_{OH}|/I_{OL}$ = 8 mA (min) (V_{CC} = 2.3 V)
$|I_{OH}|/I_{OL}$ = 4 mA (min) (V_{CC} = 1.65 V)
*V_{CC} shows the power supply voltage on the output terminal side.

(5) Small package: US8

(6) Low power dissipation: Suitable for battery-driven applications such as PDAs and cellular phones.

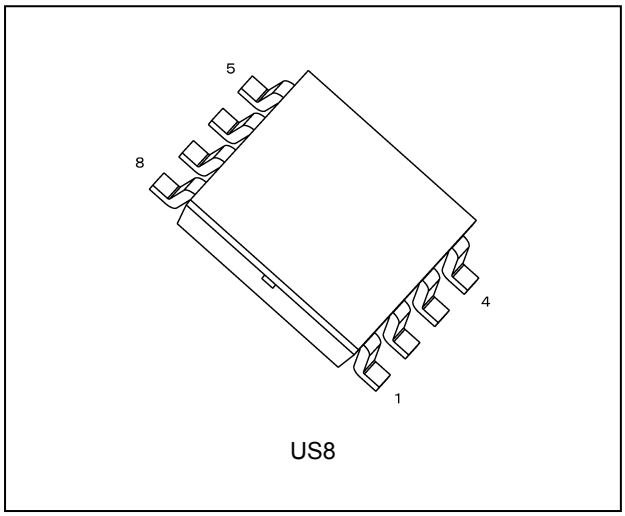
(7) Inputs and outputs are in high-impedance mode when V_{CCA} or V_{CCB} are off.

(8) 5.5 V tolerance and power-down protection are provided to all inputs and outputs.

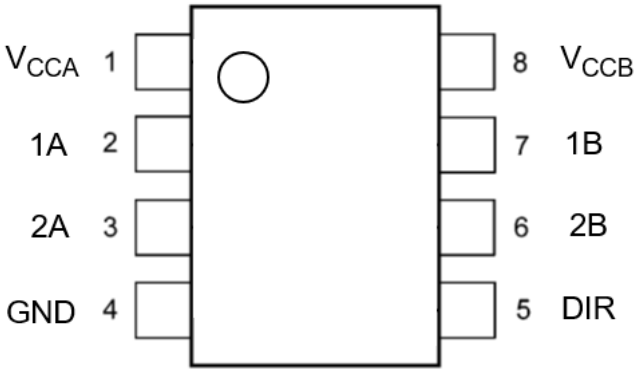
Start of commercial production
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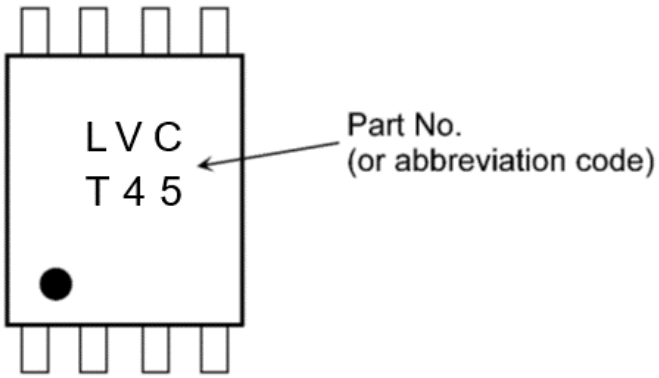
4. Packaging



5. Pin Assignment

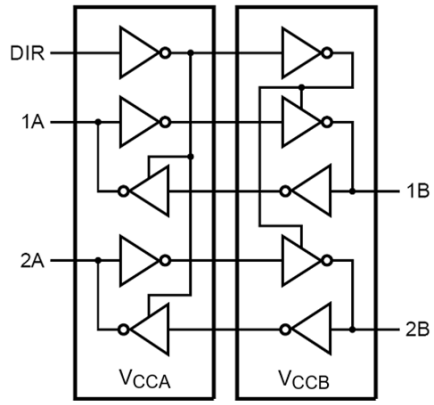


6. Marking



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7. Block Diagram



8. Truth Table

Supply voltage V_{CCA}, V_{CCB}	Input DIR	Input/Output Bus A1-A2	Input/Output Bus nB1, nB2	Function
1.65 to 5.5 V	L	Output	Input	A = B
1.65 to 5.5 V	H	Input	Output	B = A
GND (Note)	X	Z	Z	Z

X: Don't care
Z: High impedance
Note: If V_{CCA} or V_{CCB} is at GND level, the device is in suspend mode.

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9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CCA}		-0.5 to 7.0	V
	V_{CCB}		-0.5 to 7.0	
Input voltage (DIR)	V_{IN}		-0.5 to 7.0	V
Bus I/O voltage	$V_{I/OA}$	(Note 1)	-0.5 to 7.0	V
		(Note 2)	-0.5 to V_{CCA} + 0.5	
	$V_{I/OB}$	(Note 1)	-0.5 to 7.0	V
		(Note 2)	-0.5 to V_{CCB} + 0.5	
Input diode current	I_{IK}		-20	mA
I/O diode current	$I_{I/OK}$	(Note 3)	-20	mA
Output current	I_{OUTA}		±50	mA
	I_{OUTB}		±50	
V_{CC}/ground current per supply pin	I_{CCA}		±100	mA
	I_{CCB}		±100	
Power dissipation	P_D		200	mW
Storage temperature	T_{stg}		-65 to 150	°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: V_{CC} = 0 V or output high impedance state.

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

Note 3: V_{OUT} < GND

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10. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	V_{CCA}	(Note 1)	—	1.65 to 5.5	V
	V_{CCB}	(Note 1)		1.65 to 5.5	
Input voltage(DIR)	V_{IN}		—	0 to 5.5	V
Bus I/O voltage	$V_{I/OA}$	(Note 2)	—	0 to 5.5	V
		(Note 3)		0 to V_{CCA}	
	$V_{I/OB}$	(Note 2)	—	0 to 5.5	V
		(Note 3)		0 to V_{CCB}	
Output current	I_{OUTA}		V_{CC} = 4.5 to 5.5 V	±32	mA
			V_{CC} = 3.0 to 3.6 V	±24	
			V_{CC} = 2.3 to 2.7 V	±8	
			V_{CC} = 1.65 to 1.95 V	±4	
Output current	I_{OUTB}		V_{CC} = 4.5 to 5.5 V	±32	mA
			V_{CC} = 3.0 to 3.6 V	±24	
			V_{CC} = 2.3 to 2.7 V	±8	
			V_{CC} = 1.65 to 1.95 V	±4	
Operating temperature	T_{opr}		—	-40 to 125	°C
Input rise and fall times	dt/dv		V_{CC} = 1.65 to 1.95 V	0 to 20	ns/V
			V_{CC} = 2.3 to 2.7 V	0 to 20	
			V_{CC} = 3.0 to 3.6 V	0 to 10	
			V_{CC} = 4.5 to 5.5 V	0 to 5	

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

Note 1: 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 2: V_{CC} = 0 V or output high impedance state.

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

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11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition		V_{CCA} (V)	V_{CCB} (V)	Min	Max	Unit
High-level input voltage	V_{IHA}	DIR, An		1.65 to 1.95	1.65 to 5.5	V_{CCA} × 0.8	—	V
				2.3 to 2.7	1.65 to 5.5	1.7	—	
				3.0 to 3.6	1.65 to 5.5	2.0	—	
				4.5 to 5.5	1.65 to 5.5	V_{CCA} × 0.7	—	
	V_{IHB}	Bn		1.65 to 5.5	1.65 to 1.95	V_{CCB} × 0.8	—	V
				1.65 to 5.5	2.3 to 2.7	1.7	—	
				1.65 to 5.5	3.0 to 3.6	2.0	—	
				1.65 to 5.5	4.5 to 5.5	V_{CCB} × 0.7	—	
Low-level input voltage	V_{ILA}	DIR, An		1.65 to 1.95	1.65 to 5.5	—	V_{CCA} × 0.1	V
				2.3 to 2.7	1.65 to 5.5	—	0.7	
				3.0 to 3.6	1.65 to 5.5	—	0.8	
				4.5 to 5.5	1.65 to 5.5	—	V_{CCA} × 0.3	
	V_{ILB}	Bn		1.65 to 5.5	1.65 to 1.95	—	V_{CCB} × 0.1	V
				1.65 to 5.5	2.3 to 2.7	—	0.7	
				1.65 to 5.5	3.0 to 3.6	—	0.8	
				1.65 to 5.5	4.5 to 5.5	—	V_{CCB} × 0.3	
High-level output voltage	V_{OHA}	V_{IN} = V_{IH} or V_{IL}	I_{OHA} = -100 μA	1.65 to 4.5	1.65 to 5.5	V_{CCA} -0.1	—	V
			I_{OHA} = -4 mA	1.65	1.65 to 5.5	1.29	—	
			I_{OHA} = -8 mA	2.3	1.65 to 5.5	1.9	—	
			I_{OHA} = -24 mA	3.0	1.65 to 5.5	2.3	—	
			I_{OHA} = -32 mA	4.5	1.65 to 5.5	3.8	—	
	V_{OHB}	V_{IN} = V_{IH} or V_{IL}	I_{OHB} = -100 μA	1.65 to 5.5	1.65 to 4.5	V_{CCB} -0.1	—	V
			I_{OHB} = -4 mA	1.65 to 5.5	1.65	1.29	—	
			I_{OHB} = -8 mA	1.65 to 5.5	2.3	1.9	—	
			I_{OHB} = -24 mA	1.65 to 5.5	3.0	2.3	—	
			I_{OHB} = -32 mA	1.65 to 5.5	4.5	3.8	—	
Low-level output voltage	V_{OLA}	V_{IN} = V_{IH} or V_{IL}	I_{OLA} = 100 μA	1.65 to 4.5	1.65 to 5.5	—	0.1	V
			I_{OLA} = 4 mA	1.65	1.65 to 5.5	—	0.24	
			I_{OLA} = 8 mA	2.3	1.65 to 5.5	—	0.3	
			I_{OLA} = 24 mA	3.0	1.65 to 5.5	—	0.55	
			I_{OLA} = 32 mA	4.5	1.65 to 5.5	—	0.55	
	V_{OLB}	V_{IN} = V_{IH} or V_{IL}	I_{OLB} = 100 μA	1.65 to 5.5	1.65 to 4.5	—	0.1	V
			I_{OLB} = 4 mA	1.65 to 5.5	1.65	—	0.24	
			I_{OLB} = 8 mA	1.65 to 5.5	2.3	—	0.3	
			I_{OLB} = 24 mA	1.65 to 5.5	3.0	—	0.55	
			I_{OLB} = 32 mA	1.65 to 5.5	4.5	—	0.55	

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Characteristics	Symbol	Test Condition	V_{CCA} (V)	V_{CCB} (V)	Min	Max	Unit
3-state output OFF-state leakage current	I_{OZA}	V_{IN} = V_{IH} or V_{IL} V_{OUTA} = 0 to 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±1.0	μA
	I_{OZB}	V_{IN} = V_{IH} or V_{IL} V_{OUTB} = 0 to 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±1.0	
Input leakage current	I_{IN}	V_{IN} (DIR) = 0 to 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±1.0	μA
Power-OFF leakage current	I_{OFFA}	V_{OUTA} = 0 to 5.5 V	0	1.65 to 5.5	—	±1.0	μA
	I_{OFFB}	V_{OUTB} = 0 to 5.5 V	1.65 to 5.5	0	—	±1.0	
Quiescent supply current	I_{CCA}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND	1.65 to 5.5	1.65 to 5.5	—	1.0	μA
	I_{CCB}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND	1.65 to 5.5	1.65 to 5.5	—	1.0	
	I_{CCTA}	V_{INA} = V_{CCA} - 0.6 V (per input)	1.65 to 5.5	1.65 to 5.5	—	500	μA
	I_{CCTB}	V_{INB} = V_{CCB} - 0.6 V (per input)	1.65 to 5.5	1.65 to 5.5	—	500	

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

Characteristics	Symbol	Test Condition		V_{CCA} (V)	V_{CCB} (V)	Min	Max	Unit
High-level input voltage	V_{IHA}	DIR, An		1.65 to 1.95	1.65 to 5.5	V_{CCA} × 0.8	—	V
				2.3 to 2.7	1.65 to 5.5	1.7	—	
				3.0 to 3.6	1.65 to 5.5	2.0	—	
				4.5 to 5.5	1.65 to 5.5	V_{CCA} × 0.7	—	
	V_{IHB}	Bn		1.65 to 5.5	1.65 to 1.95	V_{CCB} × 0.8	—	V
				1.65 to 5.5	2.3 to 2.7	1.7	—	
				1.65 to 5.5	3.0 to 3.6	2.0	—	
				1.65 to 5.5	4.5 to 5.5	V_{CCB} × 0.7	—	
Low-level input voltage	V_{ILA}	DIR, An		1.65 to 1.95	1.65 to 5.5	—	V_{CCA} × 0.1	V
				2.3 to 2.7	1.65 to 5.5	—	0.7	
				3.0 to 3.6	1.65 to 5.5	—	0.8	
				4.5 to 5.5	1.65 to 5.5	—	V_{CCA} × 0.3	
	V_{ILB}	Bn		1.65 to 5.5	1.65 to 1.95	—	V_{CCB} × 0.1	V
				1.65 to 5.5	2.3 to 2.7	—	0.7	
				1.65 to 5.5	3.0 to 3.6	—	0.8	
				1.65 to 5.5	4.5 to 5.5	—	V_{CCB} × 0.3	
High-level output voltage	V_{OHA}	V_{IN} = V_{IH} or V_{IL}	I_{OHA} = -100 μA	1.65 to 4.5	1.65 to 5.5	V_{CCA} -0.1	—	V
			I_{OHA} = -4 mA	1.65	1.65 to 5.5	1.29	—	
			I_{OHA} = -8 mA	2.3	1.65 to 5.5	1.9	—	
			I_{OHA} = -24 mA	3.0	1.65 to 5.5	2.3	—	
			I_{OHA} = -32 mA	4.5	1.65 to 5.5	3.8	—	
	V_{OHB}	V_{IN} = V_{IH} or V_{IL}	I_{OHB} = -100 μA	1.65 to 5.5	1.65 to 4.5	V_{CCB} -0.1	—	V
			I_{OHB} = -4 mA	1.65 to 5.5	1.65	1.29	—	
			I_{OHB} = -8 mA	1.65 to 5.5	2.3	1.9	—	
			I_{OH} = -24 mA	1.65 to 5.5	3.0	2.3	—	
			I_{OHB} = -32 mA	1.65 to 5.5	4.5	3.8	—	
Low-level output voltage	V_{OLA}	V_{IN} = V_{IH} or V_{IL}	I_{OLA} = 100 μA	1.65 to 4.5	1.65 to 5.5	—	0.1	V
			I_{OLA} = 4 mA	1.65	1.65 to 5.5	—	0.24	
			I_{OLA} = 8 mA	2.3	1.65 to 5.5	—	0.3	
			I_{OLA} = 24 mA	3.0	1.65 to 5.5	—	0.55	
			I_{OLA} = 32 mA	4.5	1.65 to 5.5	—	0.55	
	V_{OLB}	V_{IN} = V_{IH} or V_{IL}	I_{OLB} = 100 μA	1.65 to 5.5	1.65 to 4.5	—	0.1	V
			I_{OLB} = 4 mA	1.65 to 5.5	1.65	—	0.24	
			I_{OLB} = 8 mA	1.65 to 5.5	2.3	—	0.3	
			I_{OLB} = 24 mA	1.65 to 5.5	3.0	—	0.55	
			I_{OLB} = 32 mA	1.65 to 5.5	4.5	—	0.55	

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Characteristics	Symbol	Test Condition	V_{CCA} (V)	V_{CCB} (V)	Min	Max	Unit
3-state output OFF-state leakage current	I_{OZA}	V_{IN} = V_{IH} or V_{IL} V_{OUTA} = 0 V to 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±10	μA
	I_{OZB}	V_{IN} = V_{IH} or V_{IL} V_{OUTB} = 0 V to 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±10	
Input leakage current	I_{IN}	V_{IN}(DIR) = 0 to 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±10	μA
Power-OFF leakage current	I_{OFFA}	V_{OUTA} = 0 to 5.5 V	0	1.65 to 5.5	—	±10	μA
	I_{OFFB}	V_{OUTB} = 0 to 5.5 V	1.65 to 5.5	0	—	±10	
Quiescent supply current	I_{CCA}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND	1.65 to 5.5	1.65 to 5.5	—	10	μA
	I_{CCB}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND	1.65 to 5.5	1.65 to 5.5	—	10	
	I_{CCTA}	V_{INA} = V_{CCA} - 0.6V (per input)	1.65 to 5.5	1.65 to 5.5	—	500	μA
	I_{CCTB}	V_{INB} = V_{CCB} - 0.6V (per input)	1.65 to 5.5	1.65 to 5.5	—	500	

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11.3. DC Characteristics (Unless otherwise specified, T_a = -40 to 125 °C)

Characteristics	Symbol	Test Condition		V_{CCA} (V)	V_{CCB} (V)	Min	Max	Unit
High-level input voltage	V_{IHA}	DIR, An		1.65 to 1.95	1.65 to 5.5	V_{CCA} × 0.8	—	V
				2.3 to 2.7	1.65 to 5.5	1.7	—	
				3.0 to 3.6	1.65 to 5.5	2.0	—	
				4.5 to 5.5	1.65 to 5.5	V_{CCA} × 0.7	—	
	V_{IHB}	Bn		1.65 to 5.5	1.65 to 1.95	V_{CCB} × 0.8	—	
				1.65 to 5.5	2.3 to 2.7	1.7	—	
				1.65 to 5.5	3.0 to 3.6	2.0	—	
				1.65 to 5.5	4.5 to 5.5	V_{CCB} × 0.7	—	
Low-level input voltage	V_{ILA}	DIR, An		1.65 to 1.95	1.65 to 5.5	—	V_{CCA} × 0.1	V
				2.3 to 2.7	1.65 to 5.5	—	0.7	
				3.0 to 3.6	1.65 to 5.5	—	0.8	
				4.5 to 5.5	1.65 to 5.5	—	V_{CCA} × 0.3	
	V_{ILB}	Bn		1.65 to 5.5	1.65 to 1.95	—	V_{CCB} × 0.1	
				1.65 to 5.5	2.3 to 2.7	—	0.7	
				1.65 to 5.5	3.0 to 3.6	—	0.8	
				1.65 to 5.5	4.5 to 5.5	—	V_{CCB} × 0.3	
High-level output voltage	V_{OHA}	V_{IN} = V_{IH} or V_{IL}	I_{OHA} = -100 μA	1.65 to 4.5	1.65 to 5.5	V_{CCA} -0.1	—	V
			I_{OHA} = -4 mA	1.65	1.65 to 5.5	0.95	—	
			I_{OHA} = -8 mA	2.3	1.65 to 5.5	1.7	—	
			I_{OHA} = -24 mA	3.0	1.65 to 5.5	2.2	—	
			I_{OHA} = -32 mA	4.5	1.65 to 5.5	3.4	—	
High-level output voltage	V_{OHB}	V_{IN} = V_{IH} or V_{IL}	I_{OHB} = -100 μA	1.65 to 5.5	1.65 to 4.5	V_{CCB} -0.1	—	V
			I_{OHB} = -4 mA	1.65 to 5.5	1.65	0.95	—	
			I_{OHB} = -8 mA	1.65 to 5.5	2.3	1.7	—	
			I_{OHB} = -24 mA	1.65 to 5.5	3.0	2.2	—	
			I_{OHB} = -32 mA	1.65 to 5.5	4.5	3.4	—	
Low-level output voltage	V_{OLA}	V_{IN} = V_{IH} or V_{IL}	I_{OLA} = 100 μA	1.65 to 4.5	1.65 to 5.5	—	0.1	V
			I_{OLA} = 4 mA	1.65	1.65 to 5.5	—	0.7	
			I_{OLA} = 8 mA	2.3	1.65 to 5.5	—	0.45	
			I_{OLA} = 24 mA	3.0	1.65 to 5.5	—	0.8	
			I_{OLA} = 32 mA	4.5	1.65 to 5.5	—	0.8	
Low-level output voltage	V_{OLB}	V_{IN} = V_{IH} or V_{IL}	I_{OLB} = 100 μA	1.65 to 5.5	1.65 to 4.5	—	0.1	V
			I_{OLB} = 4 mA	1.65 to 5.5	1.65	—	0.7	
			I_{OLB} = 8 mA	1.65 to 5.5	2.3	—	0.45	
			I_{OLB} = 24 mA	1.65 to 5.5	3.0	—	0.8	
			I_{OLB} = 32 mA	1.65 to 5.5	4.5	—	0.8	

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Characteristics	Symbol	Test Condition	V_{CCA} (V)	V_{CCB} (V)	Min	Max	Unit
3-state output OFF-state leakage current	I_{OZA}	V_{IN} = V_{IH} or V_{IL} V_{OUTA} = 0 V or 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±20	μA
	I_{OZB}	V_{IN} = V_{IH} or V_{IL} V_{OUTB} = 0 V or 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±20	
Input leakage current	I_{IN}	V_{IN} (DIR) = 0 to 5.5 V	1.65 to 5.5	1.65 to 5.5	—	±20	μA
Power-OFF leakage current	I_{OFFA}	V_{OUTA} = 0 to 5.5 V	0	1.65 to 5.5	—	±20	μA
	I_{OFFB}	V_{OUTB} = 0 to 5.5 V	1.65 to 5.5	0	—	±20	
Quiescent supply current	I_{CCA}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND	1.65 to 5.5	1.65 to 5.5	—	100	μA
	I_{CCB}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND	1.65 to 5.5	1.65 to 5.5	—	100	
	I_{CCTA}	V_{INA} = V_{CCA} - 0.6 V (per input)	1.65 to 5.5	1.65 to 5.5	—	500	μA
	I_{CCTB}	V_{INB} = V_{CCB} - 0.6 V (per input)	1.65 to 5.5	1.65 to 5.5	—	500	

11.4. AC Characteristics (Note) (V_{CCA} = 1.8 ± 0.15 V, V_{CCB} = 3.3 ± 0.3 V, C_L = 15 pF, R_L = 2 kΩ)

Characteristics	Symbol	Note	T_a = 25 °C Max	T_a = -40 to 85 °C Max	T_a = -40 to 125 °C Max	Unit
Propagation delay time (A → B)	t_{PLH}/t_{PHL}		12.4	13.2	13.2	ns
Propagation delay time (B → A)			13.0	13.0	13.0	
3-state output enable time (DIR → A)	t_{PZL}/t_{PZH}	(Note 1)	30.7	30.7	30.7	ns
3-state output enable time (DIR → B)			46.0	46.8	46.8	
3-state output disable time (DIR → A)	t_{PLZ}/t_{PHZ}		33.6	33.6	33.6	ns
3-state output disable time (DIR → B)			17.7	17.7	17.7	

Note: See Figure 12.1, 13.1, 13.2, table 12.1.1, 12.1.2, 13.1.1 for the measurement circuit.

Note 1: Output enable time is obtained from the following formula.

Output enable time (DIR → A) = Output disable time (DIR → B) + Propagation delay time (B → A)

Output enable time (DIR → B) = Output disable time (DIR → A) + Propagation delay time (A → B)

11.5. AC Characteristics (Note) (V_{CCA} = 1.8 ± 0.15 V, V_{CCB} = 5.0 ± 0.5 V, C_L = 15 pF, R_L = 2 kΩ)

Characteristics	Symbol	Note	T_a = 25 °C Max	T_a = -40 to 85 °C Max	T_a = -40 to 125 °C Max	Unit
Propagation delay time(B → A)	t_{PLH}/t_{PHL}		12.4	13.2	13.2	ns
Propagation delay time (B → A)			13.0	13.0	13.0	
3-state output enable time (DIR → A)	t_{PZL}/t_{PZH}	(Note 1)	28.0	28.0	28.0	ns
3-state output enable time (DIR → B)			46.0	46.8	46.8	
3-state output disable time (DIR → A)	t_{PLZ}/t_{PHZ}		33.6	33.6	33.6	ns
3-state output disable time (DIR → B)			15.0	15.0	15.0	

Note: See Figure 12.1, 13.1, 13.2, table 12.1.1, 12.1.2, 13.1.1 for the measurement circuit.

Note 1: Output enable time is obtained from the following formula.

Output enable time (DIR → A) = Output disable time (DIR → B) + Propagation delay time (B → A)

Output enable time (DIR → B) = Output disable time (DIR → A) + Propagation delay time (A → B)

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11.6. AC Characteristics (Note) (V_{CCA} = 3.3 ± 0.3 V, V_{CCB} = 5.0 ± 0.5 V, C_L = 15 pF, R_L = 2 kΩ)

Characteristics	Symbol	Note	T_a = 25 °C Max	T_a = -40 to 85 °C Max	T_a = -40 to 125 °C Max	Unit
Propagation delay time (A → B)	t_{PLH}/t_{PHL}		5.0	5.5	6.0	ns
Propagation delay time (B → A)			5.0	5.5	6.0	
3-state output enable time (DIR → A)	t_{PZL}/t_{PZH}	(Note 1)	12.4	14.1	15.4	ns
3-state output enable time (DIR → B)			17.8	19.7	21.5	
3-state output disable time (DIR → A)	t_{PLZ}/t_{PHZ}		12.8	14.2	15.5	ns
3-state output disable time (DIR → B)			7.4	8.6	9.4	

Note: See Figure 12.1, 13.1, 13.2, table 12.1.1, 12.1.2, 13.1.1 for the measurement circuit.

Note 1: Output enable time is obtained from the following formula.

Output enable time (DIR → A) = Output disable time (DIR → B) + Propagation delay time (B → A)

Output enable time (DIR → B) = Output disable time (DIR → A) + Propagation delay time (A → B)

11.7. AC Characteristics (Note) (V_{CCA} = 5.5 ± 0.5 V, V_{CCB} = 5.0 ± 0.5 V, C_L = 15 pF, R_L = 2 kΩ)

Characteristics	Symbol	Note	T_a = 25 °C Max	T_a = -40 to 85 °C Max	T_a = -40 to 125 °C Max	Unit
Propagation delay time (A → B)	t_{PLH}/t_{PHL}		4.0	4.5	5.0	ns
Propagation delay time (B → A)			4.0	4.5	5.0	
3-state output enable time (DIR → A)	t_{PZL}/t_{PZH}	(Note 1)	10.4	12.1	13.3	ns
3-state output enable time (DIR → B)			11.3	11.9	12.5	
3-state output disable time (DIR → A)	t_{PLZ}/t_{PHZ}		7.3	7.4	7.5	ns
3-state output disable time (DIR → B)			6.4	7.6	8.3	

Note: See Figure 12.1, 13.1, 13.2, table 12.1.1, 12.1.2, 13.1.1 for the measurement circuit.

Note 1: Output enable time is obtained from the following formula.

Output enable time (DIR → A) = Output disable time (DIR → B) + Propagation delay time (B → A)

Output enable time (DIR → B) = Output disable time (DIR → A) + Propagation delay time (A → B)

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11.8. Capacitive Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Test Condition	V_{CCA} (V)	V_{CCB} (V)	Typ.	Unit
Input capacitance	C_{IN}		DIR	3.3	3.3	4.0	pF
Bus I/O capacitance	$C_{I/O}$		An, Bn	3.3	3.3	6.0	pF
Power dissipation capacitance	C_{PDA}	(Note 1)	A → B	1.8	1.8	2	pF
				2.5	2.5	3	
				3.3	3.3	3	
				5.0	5.0	4	
		(Note 1)	B → A	1.8	1.8	15	pF
				2.5	2.5	16	
				3.3	3.3	16	
				5.0	5.0	18	
	C_{PDB}	(Note 1)	A → B	1.8	1.8	15	pF
				2.5	2.5	16	
				3.3	3.3	16	
				5.0	5.0	18	
		(Note 1)	B → A	1.8	1.8	2	pF
				2.5	2.5	3	
				3.3	3.3	3	
				5.0	5.0	4	

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.

$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$ (per bit)

12. AC Test Circuit

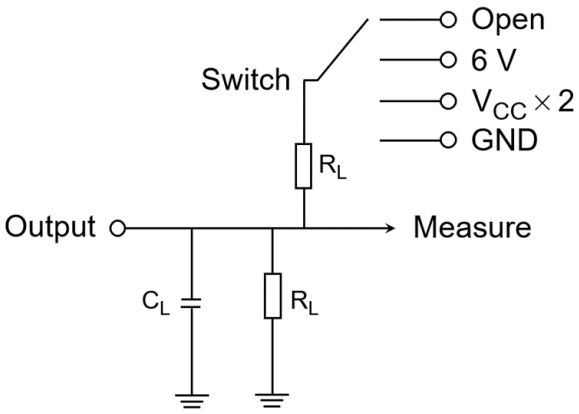


Fig. 12.1 AC Test Circuit

Table 12.1.1 Parameter for AC Test Circuit

Parameter	Switch
t_{PLH}, t_{PHL}	Open
t_{PLZ}, t_{PZL}	$V_{CC} \times 2$ @ V_{CC} = 5.0 ± 0.5 V @ V_{CC} = 3.3 ± 0.3 V @ V_{CC} = 2.5 ± 0.2 V @ V_{CC} = 1.8 ± 0.15 V
t_{PHZ}, t_{PZH}	GND

Table 12.1.2 Parameter for AC Test Circuit

Symbol	V_{CC} = 5.0 ± 0.5 V	V_{CC} = 3.3 ± 0.3 V	V_{CC} = 2.5 ± 0.2 V	V_{CC} = 1.8 ± 0.15 V
R_L	2 kΩ	2 kΩ	2 kΩ	2 kΩ
C_L	15 pF	15 pF	15 pF	15 pF

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13. AC Waveform

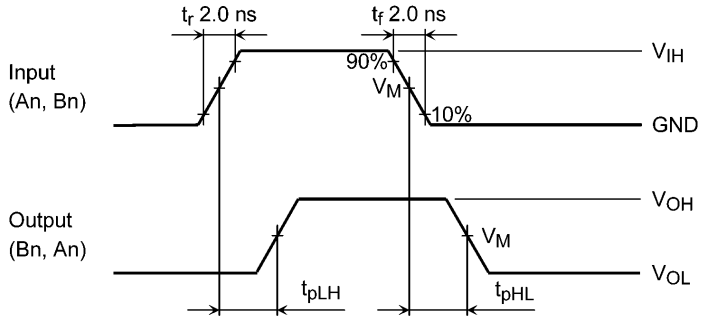


Fig. 13.1 t_{PLH}, t_{PHL}

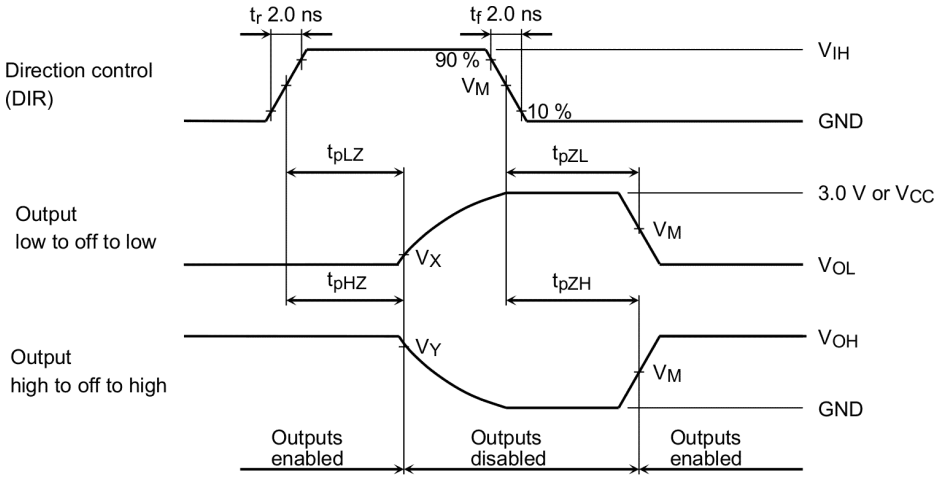


Fig. 13.2 t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

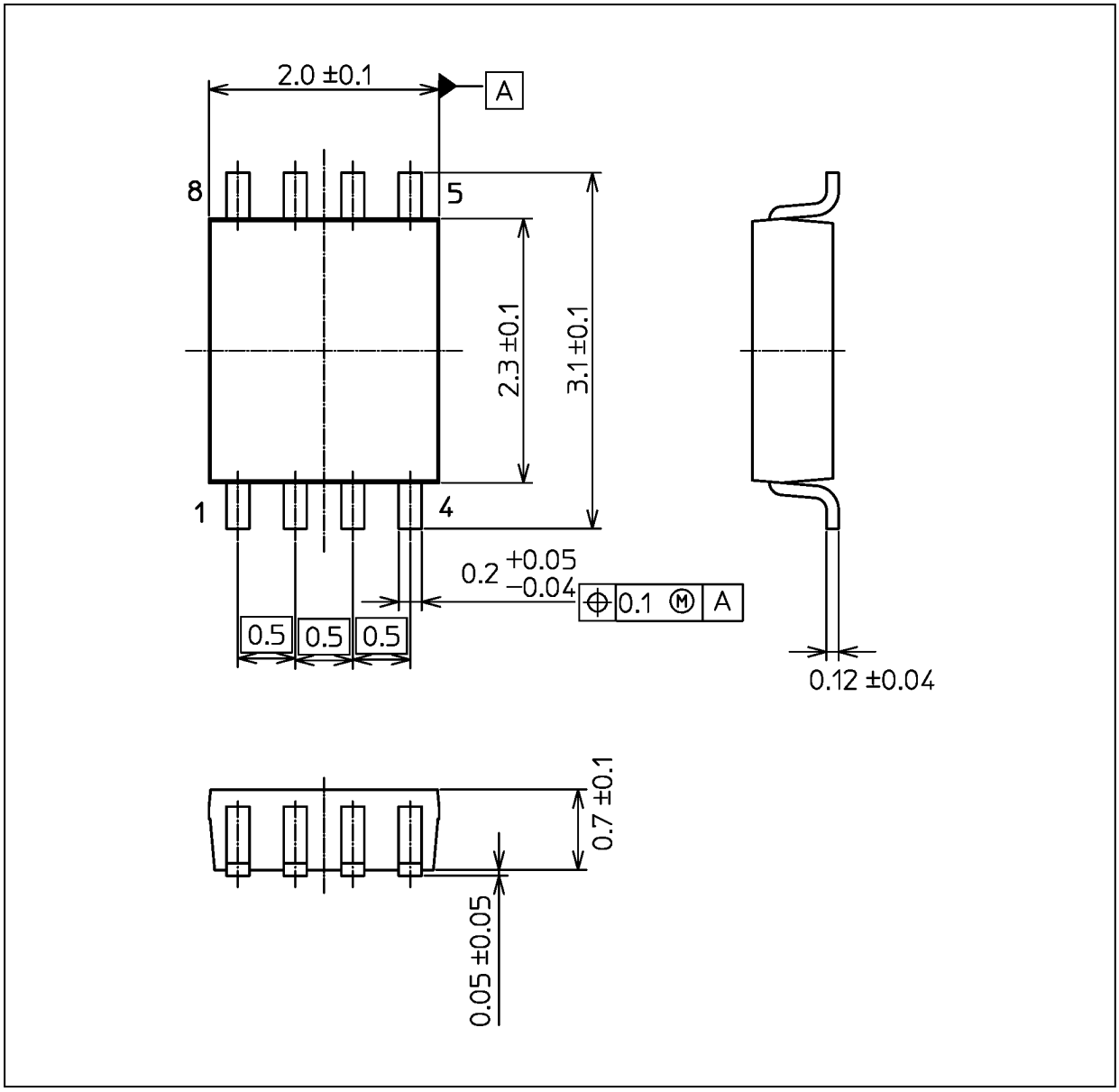
Table 13.1.1 AC Waveform Symbols

Symbol	V_{CC} = 5.0 ± 0.5 V	V_{CC} = 3.3 ± 0.3 V	V_{CC} = 2.5 ± 0.2 V	V{V_{CC} = 1.8 ± 0.15 V
V_{IH}	V_{CC}	V_{CC}	V_{CC}	V_{CC}
V_M	V_{CC}/2	V_{CC}/2	V_{CC}/2	V_{CC}/2
V_X	V_{OL} + 0.3 V	V_{OL} + 0.3 V	V_{OL} + 0.15 V	V_{OL} + 0.15 V
V_Y	V_{OH} - 0.3 V	V_{OH} - 0.3 V	V_{OH} - 0.15 V	V_{OH} - 0.15 V

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Package Dimensions

Unit: mm



Weight: 0.01 g (typ.)

Package Name(s)
Nickname: US8

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