

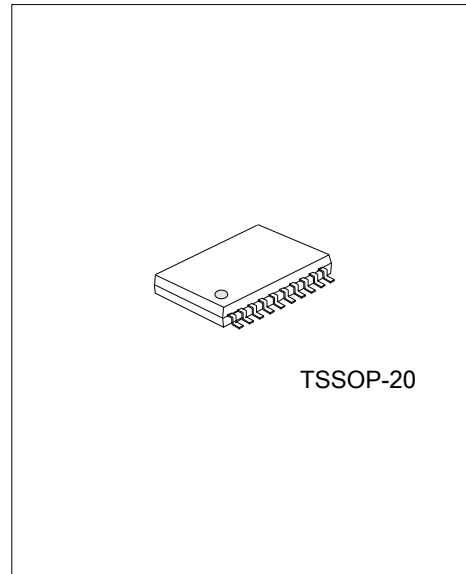


UTXS0108

Advance

CMOS IC

8-BIT BIDIRECTIONAL, LEVEL-SHIFTING, VOLTAGE TRANSLATOR FOR OPEN-DRAIN AND PUSH-PULL APPLICATION



DESCRIPTION

This 8-bit non-inverting translator is a bidirectional voltage-level translator and can be used to establish digital switching compatibility between mixed-voltage systems. It uses two separate configurable power-supply rails. The A port is designed to track V_{CCA} . V_{CCA} accepts any supply voltage from 1.4V to 3.6V. The B port is designed to track V_{CCB} . V_{CCA} must be less than or equal to V_{CCB} . V_{CCB} accepts any supply voltage from 1.65V to 5.5V. This allows for low voltage bidirectional translation between any of the 1.5V, 1.8V, 2.5V, 3.3V, and 5V voltage nodes.

When the output-enable(OE) input is low, all outputs are placed in the high-impedance state.

To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pull-down resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

FEATURES

- * 1.4V to 3.6V on A port and 1.65V to 5.5V on B Port ($V_{CCA} \leq V_{CCB}$)
- * No power-supply sequencing required – either V_{CCA} or V_{CCB} can be ramped first
- * No direction-control signal needed

APPLICATION

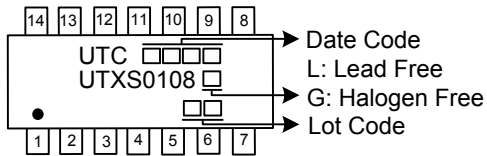
- * Handset
- * Smartphone
- * Tablet
- * Desktop PC

ORDERING INFORMATION

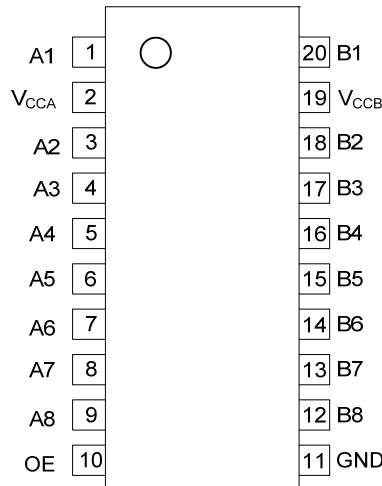
Ordering Number		Package	Packing
Lead Free	Halogen Free		
UTXS0108L-P20-R	UTXS0108G-P20-R	TSSOP-20	Tape Reel

<p>UTXS0108G-P20-R</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) R: Tape Reel (2) P20: TSSOP-20 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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MARKING



PIN CONFIGURATION



PIN DESCRIPTION

PIN NO.	PIN NAME	I/O	DESCRIPTION
1	A1	I/O	Input/output A1. Referenced to V_{CCA}
2	V_{CCA}	P	A-Port supply voltage. $1.4V \leq V_{CCA} \leq 3.6V$ and $V_{CCA} \leq V_{CCB}$
3	A2	I/O	Input/output A2. Referenced to V_{CCA}
4	A3	I/O	Input/output A3. Referenced to V_{CCA}
5	A4	I/O	Input/output A4. Referenced to V_{CCA}
6	A5	I/O	Input/output A5. Referenced to V_{CCA}
7	A6	I/O	Input/output A6. Referenced to V_{CCA}
8	A7	I/O	Input/output A7. Referenced to V_{CCA}
9	A8	I/O	Input/output A8. Referenced to V_{CCA}
10	OE	I	Output enable. Pull OE low to place all outputs in 3-state mode. Referenced to V_{CCA} .
11	GND		Ground
12	B8	I/O	Input/output B8. Referenced to V_{CCB}
13	B7	I/O	Input/output B7. Referenced to V_{CCB}
14	B6	I/O	Input/output B6. Referenced to V_{CCB}
15	B5	I/O	Input/output B5. Referenced to V_{CCB}
16	B4	I/O	Input/output B4. Referenced to V_{CCB}
17	B3	I/O	Input/output B3. Referenced to V_{CCB}
18	B2	I/O	Input/output B2. Referenced to V_{CCB}
19	V_{CCB}	P	B-Port supply voltage. $1.65V \leq V_{CCB} \leq 5.5V$
20	B1	I/O	Input/output B1. Referenced to V_{CCB}

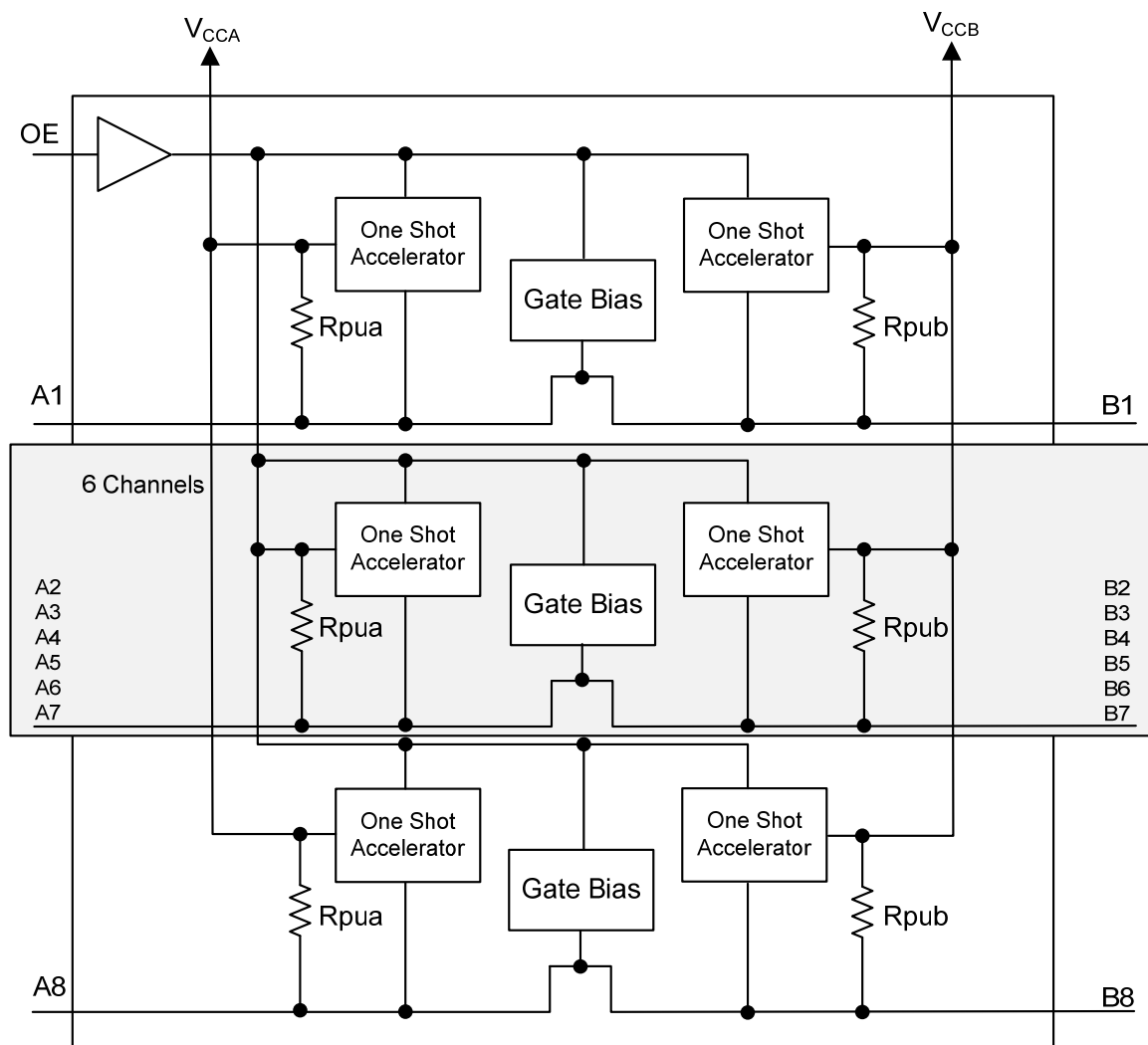
Note: I=Input, I/O=Input and Output, P=Power

FUNCTION TABLE

SUPPLY VOLTAGE		INPUTS	INPUTS/OUTPUT	
V_{CCA}	V_{CCB}	OE	An	Bn
1.4V ~ V_{CCB}	1.65V ~ 5.5V	L	Z	Z
1.4V ~ V_{CCB}	1.65V ~ 5.5V	H	Input or Output	Output or Input
GND (Note 2)	GND (Note 2)	X	Z	Z

Notes: 1. H = High voltage level ; L = Low voltage level ; Z : High impedance OFF-state ; X = Don't care.
 2. When either V_{CCA} or V_{CCB} is at GND level, the device goes into Power-down mode.

BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING ($T_A=25^\circ\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Supply voltage		V_{CCA}	-0.5 ~ 4.6	V
Supply voltage		V_{CCB}	-0.5 ~ 6.5	V
Input voltage	A Port	V_{IN}	-0.5 ~ 4.6	V
	B Port		-0.5 ~ 6.5	V
Voltage range applied to any output in the high-impedance or power-off state	A Port	V_{OUT}	-0.5 ~ 4.6	V
	B Port		-0.5 ~ 6.5	V
Voltage range applied to any output in the high or low state	A Port	V_{OUT}	$-0.5 \sim V_{CCA}+0.5$	V
	B Port		$-0.5 \sim V_{CCB}+0.5$	V
Input clamp current	$V_I < 0$	I_{IK}	-50	mA
Output clamp current	$V_O < 0$	I_{OK}	-50	mA
Continuous output current		I_O	± 50	mA
Continuous current through V_{CCA} , V_{CCB} , or GND		I_{CC} / I_{GND}	± 100	mA
Storage Temperature		T_{STG}	-65 ~ +150	$^\circ\text{C}$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ RECOMMENDED OPERATING CONDITIONS ($T_A=25^\circ\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage (Note 3)		V_{CCA}		1.4		3.6	V
Supply Voltage (Note 3)		V_{CCB}		1.65		5.5	V
Input Voltage		V_{IN}		0		V_{CCI}	V
Output Voltage	A Port I/Os	V_{OUT}	$V_{CCA}=1.4\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	0		3.6	V
	B Port I/Os		$V_{CCA}=1.4\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	0		5.5	V
High-Level Input Voltage	A Port I/Os	V_{IH}	$V_{CCA}=1.4\text{V}\sim 1.95\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	$V_{CCI}-0.2$		V_{CCI}	V
			$V_{CCA}=1.95\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	$V_{CCI}-0.4$		V_{CCI}	V
	B Port I/Os		$V_{CCA}=1.4\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	$V_{CCI}-0.4$		V_{CCI}	V
	OE		$V_{CCA}=1.4\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	$V_{CCA}\times 0.65$		5.5	V
Low-Level Input Voltage	A Port I/Os	V_{IL}	$V_{CCA}=1.4\text{V}\sim 1.95\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	0		0.15	V
			$V_{CCA}=1.95\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	0		0.15	V
	B Port I/Os		$V_{CCA}=1.4\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	0		0.15	V
	OE		$V_{CCA}=1.4\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$	0		$V_{CCA}\times 0.35$	V
Input Transition Rise or Fall Rate	A Port I/Os	$\Delta t/\Delta v$	$V_{CCA}=1.4\text{V}\sim 3.6\text{V}$, $V_{CCB}=1.65\text{V}\sim 5.5\text{V}$			10	ns/V
	B Port I/Os					10	ns/V
	OE					10	ns/V
Operating Temperature		T_A		-40		+85	$^\circ\text{C}$

Notes: 1. V_{CCI} is the supply voltage associated with the input port.
2. V_{CCO} is the supply voltage associated with the output port.
3. V_{CCA} must be less than or equal to V_{CCB} , and V_{CCA} must not exceed 3.6V.

■ ELECTRICAL CHARACTERISTICS (T_A=25°C, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Port A Output High Voltage		V _{OHA}	V _{CCA} =1.4V, V _{CCB} =1.65V~5.5V I _{OH} =-20μA, V _{IB} ≥V _{CCB} -0.4V		V _{CCA} ×0.67		V	
Port A Output Low Voltage		V _{OLA}	V _{CCA} =1.4V, V _{CCB} =1.65V~5.5V, I _{OL} =180μA, V _{IB} ≤0.15V			0.4	V	
			V _{CCA} =1.65V, V _{CCB} =1.65V~5.5V, I _{OL} =220μA, V _{IB} ≤0.15V			0.4	V	
			V _{CCA} =2.3V, V _{CCB} =1.65V~5.5V, I _{OL} =300μA, V _{IB} ≤0.15V			0.4	V	
			V _{CCA} =3.0V, V _{CCB} =1.65V~5.5V, I _{OL} =400μA, V _{IB} ≤0.15V			0.55	V	
Port B Output High Voltage		V _{OHB}	V _{CCA} =1.4V, V _{CCB} =1.65V~5.5V I _{OH} =-20μA, V _{IA} ≥V _{CCA} -0.2V		V _{CCA} ×0.67		V	
Port B Output Low Voltage		V _{OLB}	V _{CCA} =1.4V~3.6V, V _{CCB} =1.65V, I _{OL} =220μA, V _{IA} ≤0.15V			0.4	V	
			V _{CCA} =1.4V~3.6V, V _{CCB} =2.3V, I _{OL} =300μA, V _{IA} ≤0.15V			0.4	V	
			V _{CCA} =1.4V~3.6V, V _{CCB} =3.0V, I _{OL} =400μA, V _{IA} ≤0.15V			0.4	V	
			V _{CCA} =1.4V~3.6V, V _{CCB} =4.5V, I _{OL} =620μA, V _{IA} ≤0.15V			0.55	V	
Input Leakage Current	OE	I _{I(LEAK)}	V _{CCA} =1.4V, V _{CCB} =1.65V~5.5V	-1		1	μA	
High-Impedance State Output Current	A or B Port	I _{OZ}	V _{CCA} =1.4V, V _{CCB} =2.3V~5.5V	-1		1	μA	
Quiescent Supply Current		I _{CCA}	V _{IN} =V _{OUT} =Open I _O =0A	V _{CCA} =1.4V, V _{CCB} =1.65V~5.5V		1.5	μA	
				V _{CCA} =1.5V~3.6V, V _{CCB} =2.3V~5.5V			2	μA
				V _{CCA} =3.6V, V _{CCB} =0V			2	μA
				V _{CCA} =0V, V _{CCB} =5.5V			-1	μA
		I _{CCB}	V _{IN} =V _{OUT} =Open I _O =0A	V _{CCA} =1.4V, V _{CCB} =1.65V~5.5V		1.5	μA	
				V _{CCA} =1.5V~3.6V, V _{CCB} =2.3V~5.5V			6	μA
				V _{CCA} =3.6V, V _{CCB} =0V			-1	μA
				V _{CCA} =0V, V _{CCB} =5.5V			1.4	μA
		I _{CCA} +I _{CCB}	V _{IN} =V _{CCI} or GND I _O =0A	V _{CCA} =1.4V, V _{CCB} =2.3V~5.5V			3	μA
				V _{CCA} =1.5V~3.6V, V _{CCB} =2.3V~5.5V			8	μA
I _{CCZA}	V _{IN} =V _{OUT} =Open I _O =0A	V _{CCA} =1.4V, V _{CCB} =1.65V~5.5V			0.05	μA		
			OE=GND			4	μA	
Input Capacitance	OE	C _{IN}	V _{CCA} =3.3V, V _{CCB} =3.3V			4.5	pF	
Output Capacitance	A Port	C _{IO}	V _{CCA} =3.3V, V _{CCB} =3.3V			6	pF	
	B Port		V _{CCA} =3.3V, V _{CCB} =3.3V			5.5	pF	

- Notes: 1. V_{CCI} is the supply voltage associated with the input port.
 2. V_{CCO} is the supply voltage associated with the output port.
 3. V_{CCA} must be less than or equal to V_{CCB}, and V_{CCA} must not exceed 3.6V.

■ SWITCHING CHARACTERISTICS (T_A=25°C, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT			
Propagation Delay From Input (A) to Output (B)	Push-Pull Driving	t _{PHL}	V _{CCA} =1.5V±0.1V	V _{CCB} =1.8V±0.15V			11	ns		
				V _{CCB} =2.5V±0.2V			9.2	ns		
				V _{CCB} =3.3V±0.3V			8.6	ns		
				V _{CCB} =5V±0.5V			8.6	ns		
	V _{CCB} =1.8V±0.15V			4		14.4	ns			
	V _{CCB} =2.5V±0.2V			3.6		12.8	ns			
	V _{CCB} =3.3V±0.3V			3.5		12.2	ns			
	V _{CCB} =5V±0.5V			3.5		12	ns			
	Open-Drain Driving		V _{CCA} =1.8V±0.15V	V _{CCB} =1.8V±0.15V				8.2	ns	
				V _{CCB} =2.5V±0.2V				6.4	ns	
				V _{CCB} =3.3V±0.3V				5.7	ns	
				V _{CCB} =5V±0.5V				5.6	ns	
	V _{CCB} =1.8V±0.15V			3.6		11.4	ns			
	V _{CCB} =2.5V±0.2V			3.2		9.9	ns			
	V _{CCB} =3.3V±0.3V			3.1		9.3	ns			
	V _{CCB} =5V±0.5V			3.1		8.9	ns			
	Push-Pull Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V				5.0	ns	
				V _{CCB} =3.3V±0.3V				4.0	ns	
				V _{CCB} =5V±0.5V				3.7	ns	
				V _{CCB} =2.5V±0.2V	2.4		6.9	ns		
	V _{CCB} =3.3V±0.3V			2.3		6.3	ns			
	V _{CCB} =5V±0.5V			2.2		5.8	ns			
	Open-Drain Driving			V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V				3.8	ns
					V _{CCB} =5V±0.5V				3.1	ns
V _{CCB} =3.3V±0.3V	2.0		5.3		ns					
V _{CCB} =5V±0.5V	1.9		4.8		ns					

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Propagation Delay From Input (B) to Output (A)	Push-Pull Driving	t _{PHL}	V _{CCA} =1.5V±0.1V	V _{CCB} =1.8V±0.15V			12.7	ns	
				V _{CCB} =2.5V±0.2V			11.1	ns	
				V _{CCB} =3.3V±0.3V			11	ns	
				V _{CCB} =5V±0.5V			12	ns	
	V _{CCB} =1.8V±0.15V			3.4		13.2	ns		
	V _{CCB} =2.5V±0.2V			3.1		9.6	ns		
	V _{CCB} =3.3V±0.3V			2.8		8.5	ns		
	V _{CCB} =5V±0.5V			2.5		7.5	ns		
	Open-Drain Driving		V _{CCA} =1.8V±0.15V	V _{CCB} =1.8V±0.15V				9.8	ns
				V _{CCB} =2.5V±0.2V				8.0	ns
				V _{CCB} =3.3V±0.3V				7.4	ns
				V _{CCB} =5V±0.5V				7.0	ns
	V _{CCB} =1.8V±0.15V			3.4		12.1	ns		
	V _{CCB} =2.5V±0.2V			2.8		8.5	ns		
	V _{CCB} =3.3V±0.3V			2.5		7.3	ns		
	V _{CCB} =5V±0.5V			2.1		6.2	ns		
	Push-Pull Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V				5.4	ns
				V _{CCB} =3.3V±0.3V				4.7	ns
	V _{CCB} =5V±0.5V						4.2	ns	
	V _{CCB} =2.5V±0.2V			2.5		7.3	ns		
	V _{CCB} =3.3V±0.3V			2.2		6.0	ns		
	V _{CCB} =5V±0.5V			1.8		4.9	ns		
	Open-Drain Driving		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V				4.2	ns
				V _{CCB} =5V±0.5V				3.8	ns
V _{CCB} =3.3V±0.3V	2.1			5.5	ns				
V _{CCB} =5V±0.5V	1.7			4.5	ns				

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Propagation Delay From Input (A) to Output (B)	Push-Pull Driving	t _{PLH}	V _{CCA} =1.5V±0.1V	V _{CCB} =1.8V±0.15V			12	ns	
				V _{CCB} =2.5V±0.2V			10	ns	
				V _{CCB} =3.3V±0.3V			9.8	ns	
				V _{CCB} =5V±0.5V			9.7	ns	
	V _{CCB} =1.8V±0.15V			182		720	ns		
	V _{CCB} =2.5V±0.2V			143		554	ns		
	V _{CCB} =3.3V±0.3V			114		473	ns		
	V _{CCB} =5V±0.5V			81		384	ns		
	Open-Drain Driving		V _{CCA} =1.8V±0.15V	V _{CCB} =1.8V±0.15V				9.0	ns
				V _{CCB} =2.5V±0.2V				2.1	ns
				V _{CCB} =3.3V±0.3V				6.5	ns
				V _{CCB} =5V±0.5V				6.3	ns
	V _{CCB} =1.8V±0.15V			194		729	ns		
	V _{CCB} =2.5V±0.2V			155		584	ns		
	V _{CCB} =3.3V±0.3V			126		466	ns		
	V _{CCB} =5V±0.5V			90		346	ns		
	Push-Pull Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V				5.2	ns
				V _{CCB} =3.3V±0.3V				4.3	ns
	V _{CCB} =5V±0.5V						3.9	ns	
	V _{CCB} =2.5V±0.2V			149		592	ns		
	V _{CCB} =3.3V±0.3V			125		488	ns		
	V _{CCB} =5V±0.5V			93		368	ns		
	Open-Drain Driving		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V				3.9	ns
				V _{CCB} =5V±0.5V				3.5	ns
V _{CCB} =3.3V±0.3V	111			439	ns				
V _{CCB} =5V±0.5V	87			352	ns				

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT			
Propagation Delay From Input (B) to Output (A)	Push-Pull Driving	t _{PLH}	V _{CCA} =1.5V±0.1V	V _{CCB} =1.8V±0.15V			9.5	ns		
				V _{CCB} =2.5V±0.2V			6.2	ns		
				V _{CCB} =3.3V±0.3V			5.1	ns		
				V _{CCB} =5V±0.5V			1.6	ns		
	V _{CCB} =1.8V±0.15V			186		745	ns			
	V _{CCB} =2.5V±0.2V			147		603	ns			
	V _{CCB} =3.3V±0.3V			118		519	ns			
	V _{CCB} =5V±0.5V			84		407	ns			
	Open-Drain Driving		V _{CCA} =1.8V±0.15V	V _{CCB} =1.8V±0.15V				10.2	ns	
				V _{CCB} =2.5V±0.2V			7.0	ns		
				V _{CCB} =3.3V±0.3V			5.8	ns		
				V _{CCB} =5V±0.5V			5.0	ns		
	V _{CCB} =1.8V±0.15V			197		733	ns			
	V _{CCB} =2.5V±0.2V			159		578	ns			
	V _{CCB} =3.3V±0.3V			129		459	ns			
	V _{CCB} =5V±0.5V			93		323	ns			
	Push-Pull Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V				5.9	ns	
				V _{CCB} =3.3V±0.3V			4.4	ns		
				V _{CCB} =5V±0.5V			3.5	ns		
				V _{CCB} =2.5V±0.2V	150		595	ns		
	V _{CCB} =3.3V±0.3V			126		481	ns			
	V _{CCB} =5V±0.5V			94		345	ns			
	Open-Drain Driving			V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V				3.8	ns
					V _{CCB} =5V±0.5V			4.3	ns	
V _{CCB} =3.3V±0.3V	112		449		ns					
V _{CCB} =5V±0.5V	86		339		ns					

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Enable Time From Input (OE) to Output (A or B)	t_{en}	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$			200	ns	
			$V_{CCB}=2.5V\pm0.2V$			200	ns	
			$V_{CCB}=3.3V\pm0.3V$			200	ns	
			$V_{CCB}=5V\pm0.5V$			200	ns	
		$V_{CCA}=1.8V\pm0.15V$	$V_{CCB}=1.8V\pm0.15V$			200	ns	
			$V_{CCB}=2.5V\pm0.2V$			200	ns	
			$V_{CCB}=3.3V\pm0.3V$			200	ns	
			$V_{CCB}=5V\pm0.5V$			200	ns	
		$V_{CCA}=2.5V\pm0.2V$	$V_{CCB}=2.5V\pm0.2V$			200	ns	
			$V_{CCB}=3.3V\pm0.3V$			200	ns	
		$V_{CCA}=3.3V\pm0.3V$	$V_{CCB}=3.3V\pm0.3V$			200	ns	
			$V_{CCB}=5V\pm0.5V$			200	ns	
	Disable Time From Input (OE) to Output (A or B)	t_{dis}	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$			28.1	ns
				$V_{CCB}=2.5V\pm0.2V$			22	ns
				$V_{CCB}=3.3V\pm0.3V$			20.1	ns
				$V_{CCB}=5V\pm0.5V$			19.6	ns
$V_{CCA}=1.8V\pm0.15V$			$V_{CCB}=1.8V\pm0.15V$			25.1	ns	
			$V_{CCB}=2.5V\pm0.2V$			18.8	ns	
			$V_{CCB}=3.3V\pm0.3V$			16.5	ns	
			$V_{CCB}=5V\pm0.5V$			15.3	ns	
$V_{CCA}=2.5V\pm0.2V$			$V_{CCB}=2.5V\pm0.2V$			15.7	ns	
			$V_{CCB}=3.3V\pm0.3V$			12.9	ns	
$V_{CCA}=3.3V\pm0.3V$			$V_{CCB}=3.3V\pm0.3V$			11.9	ns	
			$V_{CCB}=5V\pm0.5V$			9.8	ns	

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Input Rise Time (A Port Rise Time)	Push-Pull Driving	t_{rA}	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$	3.5		13.1	ns	
				$V_{CCB}=2.5V\pm0.2V$	3.0		9.8	ns	
				$V_{CCB}=3.3V\pm0.3V$	3.1		9.0	ns	
	$V_{CCB}=5V\pm0.5V$			3.2		8.3	ns		
	Open-Drain Driving			$V_{CCB}=1.8V\pm0.15V$	147		982	ns	
				$V_{CCB}=2.5V\pm0.2V$	115		716	ns	
				$V_{CCB}=3.3V\pm0.3V$	92		592	ns	
				$V_{CCB}=5V\pm0.5V$	66		481	ns	
	Push-Pull Driving			$V_{CCA}=1.8V\pm0.15V$	$V_{CCB}=1.8V\pm0.15V$	3.1		11.9	ns
			$V_{CCB}=2.5V\pm0.2V$		2.6		8.6	ns	
			$V_{CCB}=3.3V\pm0.3V$		2.7		7.8	ns	
	$V_{CCB}=5V\pm0.5V$		2.8			7.2	ns		
	Open-Drain Driving		$V_{CCB}=1.8V\pm0.15V$		155		996	ns	
			$V_{CCB}=2.5V\pm0.2V$		124		691	ns	
			$V_{CCB}=3.3V\pm0.3V$		100		508	ns	
			$V_{CCB}=5V\pm0.5V$		72		350	ns	
	Push-Pull Driving		$V_{CCA}=2.5V\pm0.2V$		$V_{CCB}=2.5V\pm0.2V$	2.0		7.3	ns
				$V_{CCB}=3.3V\pm0.3V$	2.1		6.4	ns	
				$V_{CCB}=5V\pm0.5V$	2.2		5.8	ns	
	Open-Drain Driving			$V_{CCB}=2.5V\pm0.2V$	110		692	ns	
				$V_{CCB}=3.3V\pm0.3V$	93		529	ns	
				$V_{CCB}=5V\pm0.5V$	68		369	ns	
	Push-Pull Driving			$V_{CCA}=3.3V\pm0.3V$	$V_{CCB}=3.3V\pm0.3V$	1.8		5.7	ns
					$V_{CCB}=5V\pm0.5V$	1.9		5.0	ns
Open-Drain Driving		$V_{CCB}=3.3V\pm0.3V$			75		446	ns	
	$V_{CCB}=5V\pm0.5V$	57			337	ns			

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Input Rise Time (B Port Rise Time)	Push-Pull Driving	t_{rB}	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$	2.9		11.4	ns	
				$V_{CCB}=2.5V\pm0.2V$	1.9		7.4	ns	
				$V_{CCB}=3.3V\pm0.3V$	0.9		4.7	ns	
	$V_{CCB}=5V\pm0.5V$			0.7		2.6	ns		
	Open-Drain Driving			$V_{CCB}=1.8V\pm0.15V$	135		1020	ns	
				$V_{CCB}=2.5V\pm0.2V$	91		756	ns	
				$V_{CCB}=3.3V\pm0.3V$	58		653	ns	
	$V_{CCB}=5V\pm0.5V$			20		370	ns		
	Push-Pull Driving			$V_{CCA}=1.8V\pm0.15V$	$V_{CCB}=1.8V\pm0.15V$	2.8		10.5	ns
			$V_{CCB}=2.5V\pm0.2V$		1.8		7.2	ns	
			$V_{CCB}=3.3V\pm0.3V$		1.2		5.2	ns	
	$V_{CCB}=5V\pm0.5V$		0.7			2.7	ns		
	Open-Drain Driving		$V_{CCB}=1.8V\pm0.15V$		132		1001	ns	
			$V_{CCB}=2.5V\pm0.2V$		106		677	ns	
			$V_{CCB}=3.3V\pm0.3V$		73		546	ns	
	$V_{CCB}=5V\pm0.5V$		32			323	ns		
	Push-Pull Driving		$V_{CCA}=2.5V\pm0.2V$		$V_{CCB}=2.5V\pm0.2V$	1.8		6.5	ns
				$V_{CCB}=3.3V\pm0.3V$	1.3		5.1	ns	
				$V_{CCB}=5V\pm0.5V$	0.7		3.4	ns	
	Open-Drain Driving			$V_{CCB}=2.5V\pm0.2V$	107		693	ns	
				$V_{CCB}=3.3V\pm0.3V$	79		483	ns	
				$V_{CCB}=5V\pm0.5V$	41		304	ns	
	Push-Pull Driving			$V_{CCA}=3.3V\pm0.3V$	$V_{CCB}=3.3V\pm0.3V$	1.5		5.0	ns
					$V_{CCB}=5V\pm0.5V$	1.0		3.6	ns
Open-Drain Driving		$V_{CCB}=3.3V\pm0.3V$			72		427	ns	
	$V_{CCB}=5V\pm0.5V$	40			290	ns			

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Input Fall Time (A Port Fall Time)	Push-Pull Driving	t_{fA}	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$	2.3		9.9	ns	
				$V_{CCB}=2.5V\pm0.2V$	1.7		7.7	ns	
				$V_{CCB}=3.3V\pm0.3V$	1.6		6.8	ns	
	$V_{CCB}=5V\pm0.5V$			1.7		6.0	ns		
	Open-Drain Driving			$V_{CCB}=1.8V\pm0.15V$	2.4		10	ns	
				$V_{CCB}=2.5V\pm0.2V$	2.1		7.9	ns	
				$V_{CCB}=3.3V\pm0.3V$	1.7		7.0	ns	
	Push-Pull Driving			$V_{CCB}=5V\pm0.5V$	1.5		6.2	ns	
				$V_{CCA}=1.8V\pm0.15V$	$V_{CCB}=1.8V\pm0.15V$	2.1		8.8	ns
			$V_{CCB}=2.5V\pm0.2V$		1.6		6.6	ns	
	$V_{CCB}=3.3V\pm0.3V$		1.4			5.7	ns		
	$V_{CCB}=5V\pm0.5V$		1.4			4.9	ns		
	Open-Drain Driving		$V_{CCB}=1.8V\pm0.15V$		2.2		9.0	ns	
			$V_{CCB}=2.5V\pm0.2V$		1.7		6.7	ns	
			$V_{CCB}=3.3V\pm0.3V$		1.4		5.8	ns	
	$V_{CCB}=5V\pm0.5V$		1.2			5.2	ns		
	Push-Pull Driving		$V_{CCA}=2.5V\pm0.2V$		$V_{CCB}=2.5V\pm0.2V$	1.5		5.7	ns
				$V_{CCB}=3.3V\pm0.3V$	1.2		4.7	ns	
				$V_{CCB}=5V\pm0.5V$	1.3		3.8	ns	
	Open-Drain Driving			$V_{CCB}=2.5V\pm0.2V$	1.5		5.6	ns	
				$V_{CCB}=3.3V\pm0.3V$	1.2		4.7	ns	
				$V_{CCB}=5V\pm0.5V$	1.1		4.0	ns	
	Push-Pull Driving			$V_{CCA}=3.3V\pm0.3V$	$V_{CCB}=3.3V\pm0.3V$	1.2		4.5	ns
					$V_{CCB}=5V\pm0.5V$	1.1		3.5	ns
Open-Drain Driving		$V_{CCB}=3.3V\pm0.3V$			1.1		4.4	ns	
	$V_{CCB}=5V\pm0.5V$	1.0			3.7	ns			

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Input Fall Time (B Port Fall Time)	Push-Pull Driving	t_{fB}	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$	2.0		8.7	ns	
				$V_{CCB}=2.5V\pm0.2V$	1.3		5.5	ns	
				$V_{CCB}=3.3V\pm0.3V$	0.9		3.8	ns	
				$V_{CCB}=5V\pm0.5V$	0.8		3.1	ns	
	Open-Drain Driving			$V_{CCB}=1.8V\pm0.15V$	1.2		11.5	ns	
				$V_{CCB}=2.5V\pm0.2V$	1.3		8.6	ns	
				$V_{CCB}=3.3V\pm0.3V$	1.0		9.6	ns	
				$V_{CCB}=5V\pm0.5V$	0.5		7.7	ns	
	Push-Pull Driving		$V_{CCA}=1.8V\pm0.15V$	$V_{CCB}=1.8V\pm0.15V$	2.0		8.3	ns	
				$V_{CCB}=2.5V\pm0.2V$	1.3		5.4	ns	
				$V_{CCB}=3.3V\pm0.3V$	0.9		3.9	ns	
				$V_{CCB}=5V\pm0.5V$	0.7		3.0	ns	
	Open-Drain Driving			$V_{CCB}=1.8V\pm0.15V$	0.8		10.5	ns	
				$V_{CCB}=2.5V\pm0.2V$	0.7		10.7	ns	
				$V_{CCB}=3.3V\pm0.3V$	1.0		9.6	ns	
				$V_{CCB}=5V\pm0.5V$	0.6		7.8	ns	
	Push-Pull Driving		$V_{CCA}=2.5V\pm0.2V$	$V_{CCB}=2.5V\pm0.2V$	1.4		5.4	ns	
				$V_{CCB}=3.3V\pm0.3V$	0.9		4.1	ns	
				$V_{CCB}=5V\pm0.5V$	0.7		3.0	ns	
				$V_{CCB}=2.5V\pm0.2V$	0.4		14.2	ns	
	Open-Drain Driving			$V_{CCB}=3.3V\pm0.3V$	0.5		19.4	ns	
				$V_{CCB}=5V\pm0.5V$	0.4		3.0	ns	
	Push-Pull Driving			$V_{CCA}=3.3V\pm0.3V$	$V_{CCB}=3.3V\pm0.3V$	1.1		4.2	ns
					$V_{CCB}=5V\pm0.5V$	0.8		3.1	ns
Open-Drain Driving	$V_{CCB}=3.3V\pm0.3V$	1.0			4.2	ns			
	$V_{CCB}=5V\pm0.5V$	0.8			3.1	ns			
Data Rate	Push-Pull Driving	f_{data}	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$			40	Mbps	
				$V_{CCB}=2.5V\pm0.2V$			60	Mbps	
				$V_{CCB}=3.3V\pm0.3V$			60	Mbps	
				$V_{CCB}=5V\pm0.5V$			50	Mbps	
	Open-drain Driving			$V_{CCB}=1.8V\pm0.15V$			2	Mbps	
				$V_{CCB}=2.5V\pm0.2V$			2	Mbps	
				$V_{CCB}=3.3V\pm0.3V$			2	Mbps	
				$V_{CCB}=5V\pm0.5V$			2	Mbps	
Pulse Duration	Push-Pull Driving	t_w	$V_{CCA}=1.5V\pm0.1V$	$V_{CCB}=1.8V\pm0.15V$	25			ns	
				$V_{CCB}=2.5V\pm0.2V$	16.7			ns	
				$V_{CCB}=3.3V\pm0.3V$	16.7			ns	
				$V_{CCB}=5V\pm0.5V$	20			ns	
	Open-drain Driving			$V_{CCB}=1.8V\pm0.15V$	500				ns
				$V_{CCB}=2.5V\pm0.2V$	500				ns
				$V_{CCB}=3.3V\pm0.3V$	500				ns
				$V_{CCB}=5V\pm0.5V$	500				ns
Data Rate	Push-Pull Driving	f_{data}	$V_{CCA}=1.8V\pm0.15V$	$V_{CCB}=1.8V\pm0.15V$			40	Mbps	
				$V_{CCB}=2.5V\pm0.2V$			60	Mbps	
				$V_{CCB}=3.3V\pm0.3V$			60	Mbps	
				$V_{CCB}=5V\pm0.5V$			60	Mbps	
	Open-drain Driving			$V_{CCB}=1.8V\pm0.15V$			2	Mbps	
				$V_{CCB}=2.5V\pm0.2V$			2	Mbps	
				$V_{CCB}=3.3V\pm0.3V$			2	Mbps	
				$V_{CCB}=5V\pm0.5V$			2	Mbps	

■ SWITCHING CHARACTERISTICS (Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Pulse Duration	Push-Pull Driving	t_w	$V_{CCA}=1.8V\pm0.15V$	$V_{CCB}=1.8V\pm0.15V$	25		ns
				$V_{CCB}=2.5V\pm0.2V$	16.7		ns
				$V_{CCB}=3.3V\pm0.3V$	16.7		ns
	Open-drain Driving			$V_{CCB}=5V\pm0.5V$	16.7		ns
				$V_{CCB}=1.8V\pm0.15V$	500		ns
				$V_{CCB}=2.5V\pm0.2V$	500		ns
				$V_{CCB}=3.3V\pm0.3V$	500		ns
$V_{CCB}=5V\pm0.5V$	500		ns				
Data Rate	Push-Pull Driving	f_{data}	$V_{CCA}=2.5V\pm0.2V$	$V_{CCB}=2.5V\pm0.2V$		60	Mbps
				$V_{CCB}=3.3V\pm0.3V$		60	Mbps
				$V_{CCB}=5V\pm0.5V$		60	Mbps
	Open-drain Driving			$V_{CCB}=2.5V\pm0.2V$		2	Mbps
				$V_{CCB}=3.3V\pm0.3V$		2	Mbps
				$V_{CCB}=5V\pm0.5V$		2	Mbps
Pulse Duration	Push-Pull Driving	t_w	$V_{CCA}=2.5V\pm0.2V$	$V_{CCB}=2.5V\pm0.2V$	16.7		ns
				$V_{CCB}=3.3V\pm0.3V$	16.7		ns
				$V_{CCB}=5V\pm0.5V$	16.7		ns
	Open-drain Driving			$V_{CCB}=2.5V\pm0.2V$	500		ns
				$V_{CCB}=3.3V\pm0.3V$	500		ns
				$V_{CCB}=5V\pm0.5V$	500		ns
Data Rate	Push-Pull Driving	f_{data}	$V_{CCA}=3.3V\pm0.3V$	$V_{CCB}=3.3V\pm0.3V$		60	Mbps
				$V_{CCB}=5V\pm0.5V$		60	Mbps
	Open-drain Driving			$V_{CCB}=3.3V\pm0.3V$		2	Mbps
				$V_{CCB}=5V\pm0.5V$		2	Mbps
Pulse Duration	Push-Pull Driving	t_w	$V_{CCA}=3.3V\pm0.3V$	$V_{CCB}=3.3V\pm0.3V$	16.7		ns
				$V_{CCB}=5V\pm0.5V$	16.7		ns
	Open-drain Driving			$V_{CCB}=3.3V\pm0.3V$	500		ns
				$V_{CCB}=5V\pm0.5V$	500		ns

■ OPERATING CHARACTERISTICS (T_A=25°C, unless otherwise specified)

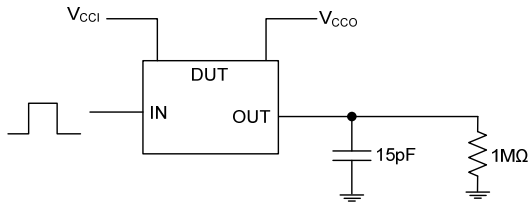
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
Power Dissipation Capacitance	A Port Input B Port Output	C _{PDA}	C _L =0, f=10MHz t _r =t _f =1nS OE=V _{CCA} (Output Enabled)	V _{CCA} =1.5V V _{CCB} =1.5V		5.9		pF	
				V _{CCA} =1.8V V _{CCB} =1.8V		5.9		pF	
				V _{CCA} =2.5V V _{CCB} =2.5V		6.7		pF	
				V _{CCA} =3.3V V _{CCB} =3.3V		8.0		pF	
	V _{CCA} =1.5V V _{CCB} =1.5V				9.9		pF		
	V _{CCA} =1.8V V _{CCB} =1.8V				9.7		pF		
	V _{CCA} =2.5V V _{CCB} =2.5V				9.4		pF		
	V _{CCA} =3.3V V _{CCB} =3.3V				9.8		pF		
	B Port Input A Port Output		C _L =0, f=10MHz t _r =t _f =1nS OE=GND (Output Disabled)	V _{CCA} =1.5V V _{CCB} =1.5V		0.01		pF	
				V _{CCA} =1.8V V _{CCB} =1.8V		0.01		pF	
				V _{CCA} =2.5V V _{CCB} =2.5V		0.01		pF	
				V _{CCA} =3.3V V _{CCB} =3.3V		0.01		pF	
	A Port Input B Port Output			C _L =0, f=10MHz t _r =t _f =1nS OE=GND (Output Disabled)	V _{CCA} =1.5V V _{CCB} =1.5V		0.01		pF
					V _{CCA} =1.8V V _{CCB} =1.8V		0.01		pF
					V _{CCA} =2.5V V _{CCB} =2.5V		0.01		pF
					V _{CCA} =3.3V V _{CCB} =3.3V		0.01		pF
B Port Input A Port Output	C _L =0, f=10MHz t _r =t _f =1nS OE=GND (Output Disabled)	V _{CCA} =1.5V V _{CCB} =1.5V			0.01		pF		
		V _{CCA} =1.8V V _{CCB} =1.8V			0.01		pF		
		V _{CCA} =2.5V V _{CCB} =2.5V			0.01		pF		
		V _{CCA} =3.3V V _{CCB} =3.3V			0.01		pF		

■ OPERATING CHARACTERISTICS (Cont.)

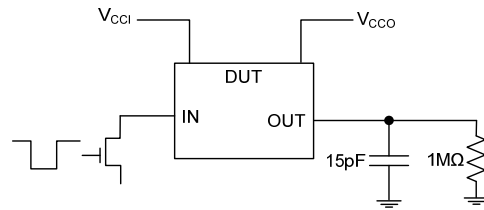
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Power Dissipation Capacitance	A Port Input B Port Output	C _{PDB}	C _L =0, f=10MHz t _r =t _f =1nS OE=V _{CCA} (Output Enabled)	V _{CCA} =1.5V V _{CCB} =1.5V		21.5		pF
				V _{CCA} =1.8V V _{CCB} =1.8V		20.8		pF
				V _{CCA} =2.5V V _{CCB} =2.5V		21		pF
				V _{CCA} =3.3V V _{CCB} =3.3V		23		pF
	B Port Input A Port Output			V _{CCA} =1.5V V _{CCB} =1.5V		16.7		pF
				V _{CCA} =1.8V V _{CCB} =1.8V		16.8		pF
				V _{CCA} =2.5V V _{CCB} =2.5V		17.8		pF
				V _{CCA} =3.3V V _{CCB} =3.3V		20.9		pF
	A Port Input B Port Output		C _L =0, f=10MHz t _r =t _f =1nS OE=GND (Output Disabled)	V _{CCA} =1.5V V _{CCB} =1.5V		0.01		pF
				V _{CCA} =1.8V V _{CCB} =1.8V		0.01		pF
				V _{CCA} =2.5V V _{CCB} =2.5V		0.01		pF
				V _{CCA} =3.3V V _{CCB} =3.3V		0.02		pF
	B Port Input A Port Output			V _{CCA} =1.5V V _{CCB} =1.5V		0.01		pF
				V _{CCA} =1.8V V _{CCB} =1.8V		0.01		pF
				V _{CCA} =2.5V V _{CCB} =2.5V		0.01		pF
				V _{CCA} =3.3V V _{CCB} =3.3V		0.02		pF

TEST CIRCUIT AND WAVEFORMS

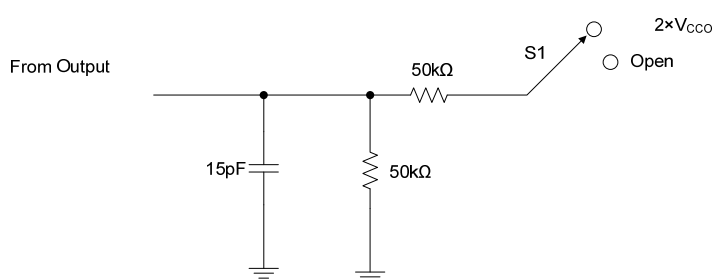
Load Circuits



Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using a Push-Pull Driver

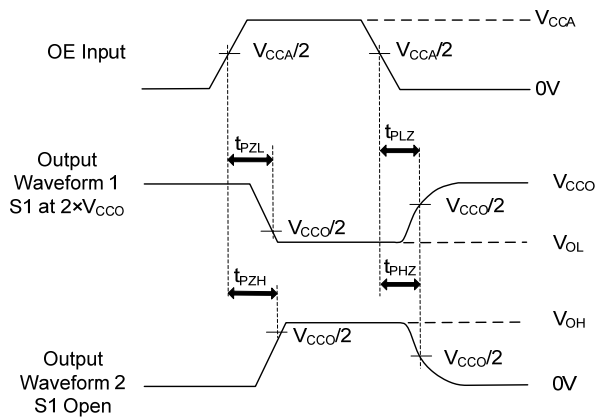
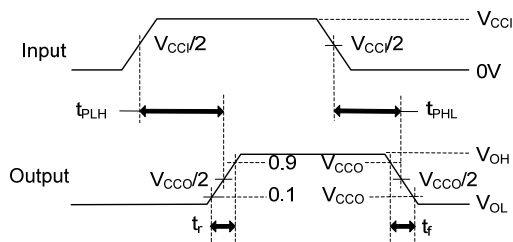
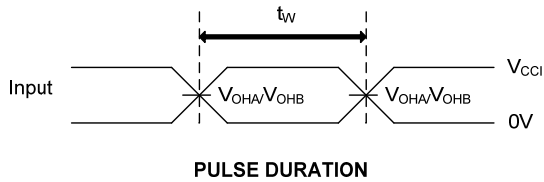


Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using an Open-Drain Driver



TEST	S1
t_{PZL}/t_{PLZ}	$2 \times V_{CCO}$
t_{PHZ}/t_{PZH}	Open

- Notes: 1. V_{CCI} is the supply voltage associated with the input.
- 2. V_{CCO} is the supply voltage associated with the input.
- 3. t_{en} is the same as t_{PZL} and t_{PZH} .
- t_{dis} is the same as t_{PLZ} and t_{PHZ} .



■ DETAILED DESCRIPTION

Overview

The **UTXS0108** can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The **UTXS0108** is ideal for use in applications where an open-drain driver is connected to the data I/Os. The **UTXS0108** can also be used in applications where a push-pull driver is connected to the data I/Os, but the **UTXB0104** might be a better option for such push-pull applications. The **UTXS0108** device is a semi-buffered auto-direction-sensing voltage translator design is optimized for translation applications (e.g. MMC Card Interfaces) that require the system to start out in a low-speed open-drain mode and then switch to a higher speed push-pull mode.

Architecture

To address these application requirements, a semi-buffered architecture design is used and is illustrated below (see Figure 1). Edge-rate accelerator circuitry (for both the high-to-low and low-to-high edges), a High-Ron n-channel pass-gate transistor (on the order of 300Ω to 500Ω) and pull-up resistors (to provide DC-bias and drive capabilities) are included to realize this solution. A direction-control signal (to control the direction of data flow from A to B or from B to A) is not needed. The resulting implementation supports both low-speed open-drain operation as well as high-speed push-pull operation.

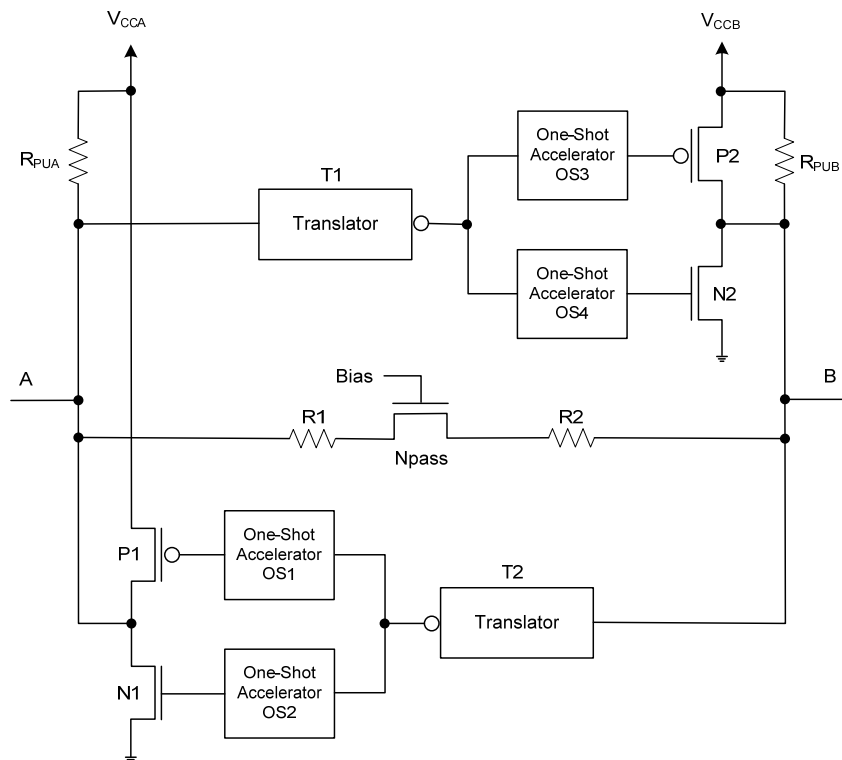


Figure 1. Architecture of UTXS0108 I/O Cell

When transmitting data from A to B ports, during a rising edge the One-Shot (OS3) turns on the PMOS transistor (P2) for a short-duration and this speeds up the low-to-high transition. Similarly, during a falling edge, when transmitting data from A to B, the One-Shot (OS4) turns on NMOS transistor (N2) for a short-duration and this speeds up the high-to-low transition. The B port edge-rate accelerator consists of one-shots OS3 and OS4, Transistors P2 and N2 and serves to rapidly force the B port high or low when a corresponding transition is detected on the A port.

When transmitting data from B to A ports, during a rising edge the One-Shot (OS1) turns on the PMOS transistor (P1) for a short-duration and this speeds up the low-to-high transition. Similarly, during a falling edge, when transmitting data from B to A, the One-Shot (OS2) turns on NMOS transistor (N1) for a short-duration and this speeds up the high-to-low transition. The A port edge-rate accelerator consists of one-shots OS1 and OS2, Transistors P1 and N1 components and form the edge-rate accelerator and serves to rapidly force the A port high or low when a corresponding transition is detected on the B port.

■ DETAILED DESCRIPTION (Cont.)**Power-Up**

During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \geq V_{CCB}$ does not damage the device, so any power supply can be ramped up first.

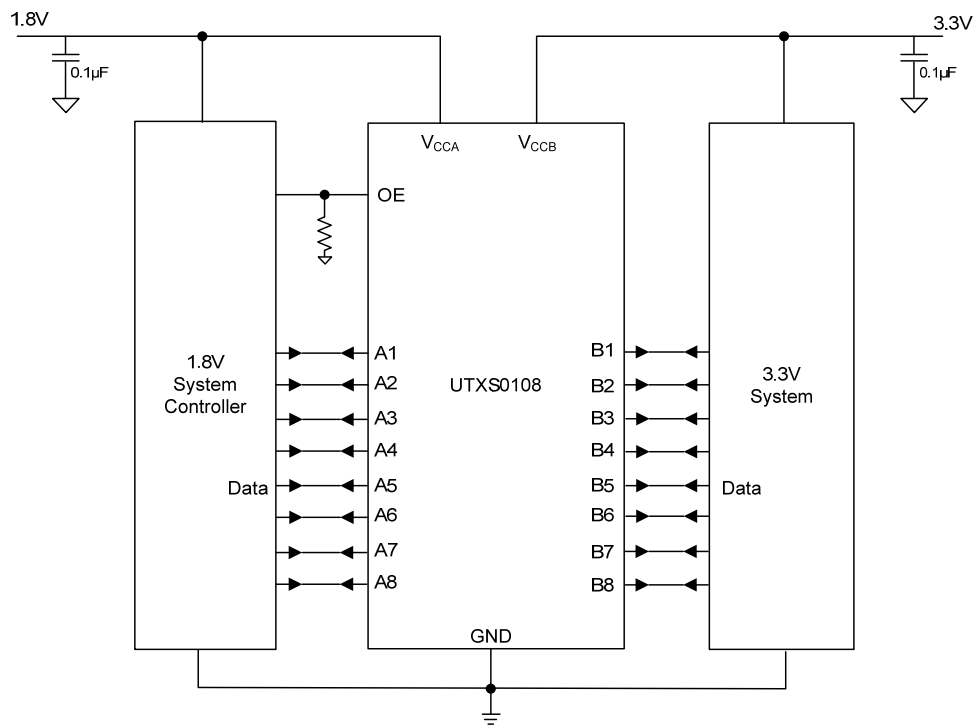
Enable and Disable

The **UTXS0108** has an OE input that is used to disable the device by setting OE low, which places all I/Os in the Hi-Z state. The disable time (t_{dis}) indicates the delay between the time when OE goes low and when the outputs actually get disabled (Hi-Z). The enable time (t_{en}) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

Pull-up or Pull-down Resistors on I/O Lines

Each A port I/O has a pull-up resistor (R_{pua}) to V_{CCA} and each B port I/O has a pull-up resistor (R_{pub}) to V_{CCB} . R_{pua} and R_{pub} have a value of 40k Ω when the output is driving low. R_{pua} and R_{pub} have a value of 4k Ω when the output is driving high. R_{pua} and R_{pub} are disabled when OE = Low.

■ TYPICAL APPLICATION CIRCUIT



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