



4-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR FOR OPEN-DRAIN AND PUSH-PULL APPLICATION

DESCRIPTION

This 4-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 1.65V 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 2.3V to 5.5V. This allows for low voltage bidirectional translation between any of the 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.

The **UTXS0104** is designed so that the OE input circuit is supplied by V_{CCA} .

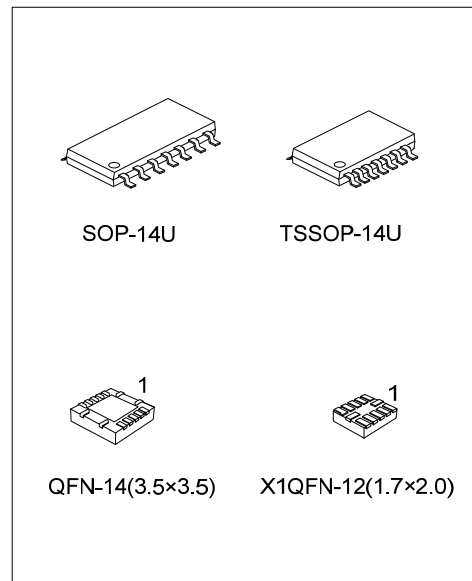
To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pull-down resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

FEATURES

- * 1.65V to 3.6V on A Port and 2.3V to 5.5V on B Port ($V_{CCA} \leq V_{CCB}$)
- * No Direction-Control Signal Needed
- * No Power-Supply Sequencing Required – Either V_{CCA} or V_{CCB} Can be Ramped First

APPLICATION

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



ORDERING INFORMATION

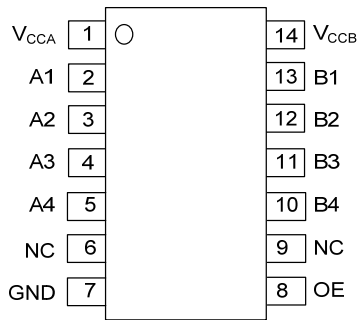
Ordering Number		Package	Packing
Lead Free	Halogen Free		
UTXS0104L-UEA-R	UTXS0104G-UEA-R	SOP-14U	Tape Reel
UTXS0104L-UEB-R	UTXS0104G-UEB-R	TSSOP-14U	Tape Reel
UTXS0104L-QAC-R	UTXS0104G-QAC-R	X1QFN-12(1.7×2.0)	Tape Reel
UTXS0104L-QAJ-R	UTXS0104G-QAJ-R	QFN-14(3.5×3.5)	Tape Reel

<p>UTXS0104G-UEA-R</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) R: Tape Reel (2) UEA: SOP-14U, UEB: TSSOP-14U, QAC: X1QFN-12(1.7×2.0), QAJ: QFN-14(3.5×3.5) (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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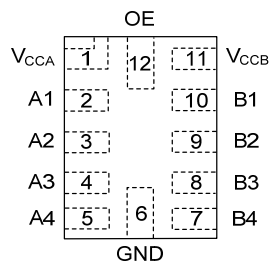
MARKING

<p>SOP-14U</p> <p>Date Code L: Lead Free G: Halogen Free Lot Code</p>	<p>TSSOP-14U</p> <p>Date Code L: Lead Free G: Halogen Free Lot Code</p>
<p>X1QFN-12(1.7×2.0)</p> <p>S04</p>	<p>QFN-14(3.5×3.5)</p> <p>L: Lead Free G: Halogen Free Date Code Lot Code</p>

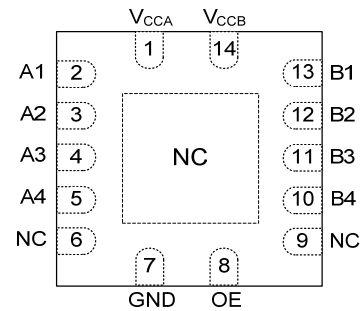
PIN CONFIGURATION



SOP-14U / TSSOP-14U



X1QFN-12(1.7×2.0)
(TOP View)



QFN-14(3.5×3.5)
(TOP View)

PIN DESCRIPTION

PIN NO.			PIN NAME	I/O	DESCRIPTION
SOP-14U TSSOP-14U	X1QFN-12(1.7×2.0)	QFN-14(3.5×3.5)			
1	1	1	V _{CCA}		A-port supply voltage $1.65V \leq V_{CCA} \leq 3.6V$ and $V_{CCA} \leq V_{CCB}$.
2	2	2	A1	I/O	Input/output A1. Referenced to V _{CCA}
3	3	3	A2	I/O	Input/output A2. Referenced to V _{CCA}
4	4	4	A3	I/O	Input/output A3. Referenced to V _{CCA}
5	5	5	A4	I/O	Input/output A4. Referenced to V _{CCA}
6	-	6	NC		No connection. Not internally connected.
7	6	7	GND		Ground
8	12	8	OE	I	Output enable. Pull OE low to place all outputs in 3-state mode. Referenced to V _{CCA}
9	-	9	NC		No connection. Not internally connected.
10	7	10	B4	I/O	Input/output B4. Referenced to V _{CCB}
11	8	11	B3	I/O	Input/output B3. Referenced to V _{CCB}
12	9	12	B2	I/O	Input/output B2. Referenced to V _{CCB}
13	10	13	B1	I/O	Input/output B1. Referenced to V _{CCB}
14	11	14	V _{CCB}		B-port supply voltage $2.3V \leq V_{CCB} \leq 5.5V$
-	-	Exposed Pad	NC		Thermal pad

Note: I=Input, I/O=Input and Output.

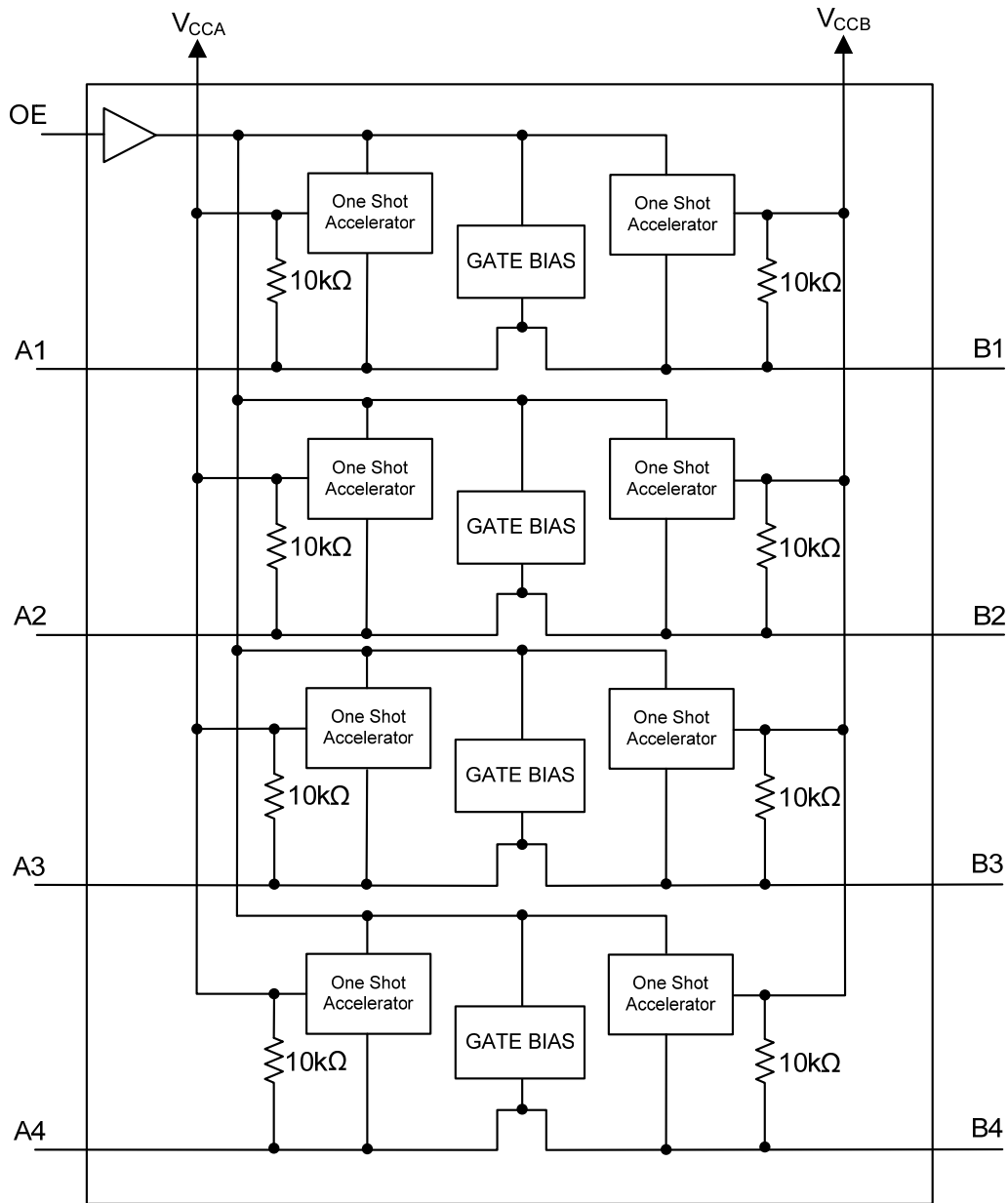
FUNCTION TABLE

SUPPLY VOLTAGE		INPUT	INPUT/OUTPUT	
V _{CCA}	V _{CCB}	OE	A _n	B _n
1.65V ~ V _{CCB}	2.3V ~ 5.5V	L	Z	Z
1.65V ~ V _{CCB}	2.3V ~ 5.5V	H	Input or Output	Output or Input
GND	GND	X	Z	Z

Notes: 1. H = High voltage level ; L = Low voltage level ; X = Don't care ; Z = high-impedance OFF-state

2. When either V_{CCA} or V_{CCB} is at GND level, the device goes into power-down mode.

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING (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 ~ $V_{CCA}+0.5$	V
	B Port		-0.5 ~ $V_{CCB}+0.5$	V
Input Clamp Current	$V_{IN}<0$	I_{IK}	-50	mA
Output Clamp Current	$V_{OUT}<0$	I_{OK}	-50	mA
Continuous Output Current		I_{OUT}	±50	mA
Continuous Current Through V_{CCA} , V_{CCB} , or GND		I_{CC} / I_{GND}	±100	mA
Storage Temperature		T_{STG}	-65 ~ +150	°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 (Unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage (Note 3)		V_{CCA}		1.65		3.6	V
Supply Voltage (Note 3)		V_{CCB}		2.3		5.5	V
Input Voltage		V_{IN}		0		V_{CCI}	V
Output Voltage	A Port I/Os	V_{OUT}	$V_{CCA}=1.65V\sim 3.6V,$ $V_{CCB}=2.3V\sim 5.5V$	0		3.6	V
	B Port I/Os			0		5.5	V
High-Level Input Voltage	A Port I/Os	V_{IH}	$V_{CCA}=1.65V\sim 1.95V,$ $V_{CCB}=2.3V\sim 5.5V$	$V_{CCI}-0.2$		V_{CCI}	V
				$V_{CCI}-0.4$		V_{CCI}	V
	B Port I/Os		$V_{CCA}=1.65V\sim 3.6V,$ $V_{CCB}=2.3V\sim 5.5V$	$V_{CCI}-0.4$		V_{CCI}	V
	OE Input			$V_{CCA}\times 0.65$		5.5	V
Low-Level Input Voltage	A Port I/Os	V_{IL}	$V_{CCA}=1.65V\sim 3.6V,$ $V_{CCB}=2.3V\sim 5.5V$	0		0.15	V
	B Port I/Os			0		0.15	V
	OE Input			0		$V_{CCA}\times 0.35$	V
Input Transition Rise or Fall Rate	A Port I/Os	$\Delta t/\Delta v$	$V_{CCA}=1.65V\sim 3.6V,$ $V_{CCB}=2.3V\sim 5.5V$			10	ns/V
	B Port I/Os					10	ns/V
	OE Input					10	ns/V
Operating Temperature		T_A		-40		+125	°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 (Unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Port A Output High Voltage		V_{OHA}	$V_{CCA}=1.65V\sim 3.6V$, $V_{CCB}=2.3V\sim 5.5V$, $I_{OH}=-20\mu A$, $V_{IB}\geq V_{CCB}-0.4V$	V_{CCA} $\times 0.8$			V	
Port A Output Low Voltage		V_{OLA}	$V_{CCA}=1.65V\sim 3.6V$, $V_{CCB}=2.3V\sim 5.5V$, $I_{OL}=1mA$, $V_{IB}\leq 0.15V$			0.4	V	
Port B Output High Voltage		V_{OHB}	$V_{CCA}=1.65V\sim 3.6V$, $V_{CCB}=2.3V\sim 5.5V$, $I_{OH}=-20\mu A$, $V_{IA}\geq V_{CCA}-0.2V$	V_{CCB} $\times 0.8$			V	
Port B Output Low Voltage		V_{OLB}	$V_{CCA}=1.65V\sim 3.6V$, $V_{CCB}=2.3V\sim 5.5V$, $I_{OL}=1mA$, $V_{IA}\leq 0.15V$			0.4	V	
Input Leakage Current	OE	$I_{I(LEAK)}$	$V_{CCA}=1.65V\sim 3.6V$, $V_{CCB}=2.3V\sim 5.5V$	-1		1	μA	
High-Impedance State Output Current	A or B Port	I_{OZ}	$V_{CCA}=1.65V\sim 3.6V$, $V_{CCB}=2.3V\sim 5.5V$, OE=GND	-1		1	μA	
Supply Current		I_{CCA}	$V_I=V_O=Open$, $I_O=0A$	$V_{CCA}=1.65V\sim V_{CCB}$, $V_{CCB}=2.3V\sim 5.5V$			2.4	μA
				$V_{CCA}=3.6V$, $V_{CCB}=0V$			2.2	μA
				$V_{CCA}=0V$, $V_{CCB}=5.5V$			-1	μA
		I_{CCB}		$V_{CCA}=1.65V\sim V_{CCB}$, $V_{CCB}=2.3V\sim 5.5V$			12	μA
				$V_{CCA}=3.6V$, $V_{CCB}=0V$			-1	μA
				$V_{CCA}=0V$, $V_{CCB}=5.5V$			1	μA
		$I_{CCA}+I_{CCB}$		$V_{CCA}=1.65V\sim V_{CCB}$, $V_{CCB}=2.3V\sim 5.5V$				14.4
Input Capacitance	OE	C_{IN}			2.5	pF		
Output Capacitance	A Port	C_{IO}	$V_{CCA}=3.3V$, $V_{CCB}=3.3V$			5	pF	
	B Port					12	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 (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} =1.8V±0.15V	V _{CCB} =2.5V±0.2V		5.8	ns		
				V _{CCB} =3.3V±0.3V		5.9	ns		
				V _{CCB} =5V±0.5V		7.3	ns		
				V _{CCB} =2.5V±0.2V	2.9	8.8	ns		
				V _{CCB} =3.3V±0.3V	2.9	9.6	ns		
				V _{CCB} =5V±0.5V	3	10	ns		
	Open-Drain Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		4.0	ns		
				V _{CCB} =3.3V±0.3V		4.2	ns		
				V _{CCB} =5V±0.5V		4.3	ns		
				V _{CCB} =2.5V±0.2V	1.7	6.3	ns		
				V _{CCB} =3.3V±0.3V	2	6.0	ns		
				V _{CCB} =5V±0.5V	2.1	5.8	ns		
	Push-Pull Driving		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		3.0	ns		
				V _{CCB} =5V±0.5V		3.9	ns		
				V _{CCB} =3.3V±0.3V	1.3	4.2	ns		
				V _{CCB} =5V±0.5V	1.4	4.6	ns		
				Open-Drain Driving	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V		5.5	ns
						V _{CCB} =3.3V±0.3V		5.7	ns
V _{CCB} =5V±0.5V		5.9	ns						
V _{CCB} =2.5V±0.2V	1.9	5.3	ns						
V _{CCB} =3.3V±0.3V	1.1	4.4	ns						
V _{CCB} =5V±0.5V	1.2	4.0	ns						
Push-Pull Driving	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		3.8	ns				
		V _{CCB} =3.3V±0.3V		4.5	ns				
		V _{CCB} =5V±0.5V		5.4	ns				
		V _{CCB} =2.5V±0.2V	1.8	4.7	ns				
		V _{CCB} =3.3V±0.3V	2.6	4.2	ns				
		V _{CCB} =5V±0.5V	1.2	4.0	ns				
Open-Drain Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		3.2	ns				
		V _{CCB} =5V±0.5V		4.2	ns				
		V _{CCB} =3.3V±0.3V	1	124	ns				
		V _{CCB} =5V±0.5V	1	97	ns				
		Push-Pull Driving	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V		8.5	ns		
				V _{CCB} =3.3V±0.3V		8.5	ns		
V _{CCB} =5V±0.5V				8.8	ns				
V _{CCB} =2.5V±0.2V	45			260	ns				
V _{CCB} =3.3V±0.3V	36			208	ns				
V _{CCB} =5V±0.5V	27			198	ns				
Open-Drain Driving	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		6.5	ns				
		V _{CCB} =3.3V±0.3V		6.9	ns				
		V _{CCB} =5V±0.5V		7.2	ns				
		V _{CCB} =2.5V±0.2V	43	250	ns				
		V _{CCB} =3.3V±0.3V	36	206	ns				
		V _{CCB} =5V±0.5V	27	190	ns				
Push-Pull Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		5.3	ns				
		V _{CCB} =5V±0.5V		5.5	ns				
		V _{CCB} =3.3V±0.3V	36	204	ns				
		V _{CCB} =5V±0.5V	28	165	ns				
		Open-Drain Driving	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V		8.5	ns		
				V _{CCB} =3.3V±0.3V		8.5	ns		
V _{CCB} =5V±0.5V				8.8	ns				
V _{CCB} =2.5V±0.2V	45			260	ns				
V _{CCB} =3.3V±0.3V	36			208	ns				
V _{CCB} =5V±0.5V	27			198	ns				
Open-Drain Driving	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		6.5	ns				
		V _{CCB} =3.3V±0.3V		6.9	ns				
		V _{CCB} =5V±0.5V		7.2	ns				
		V _{CCB} =2.5V±0.2V	43	250	ns				
		V _{CCB} =3.3V±0.3V	36	206	ns				
		V _{CCB} =5V±0.5V	27	190	ns				
Push-Pull Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		5.3	ns				
		V _{CCB} =5V±0.5V		5.5	ns				
		V _{CCB} =3.3V±0.3V	36	204	ns				
		V _{CCB} =5V±0.5V	28	165	ns				
		Open-Drain Driving	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V		8.5	ns		
				V _{CCB} =3.3V±0.3V		8.5	ns		
V _{CCB} =5V±0.5V				8.8	ns				
V _{CCB} =2.5V±0.2V	45			260	ns				
V _{CCB} =3.3V±0.3V	36			208	ns				
V _{CCB} =5V±0.5V	27			198	ns				
Open-Drain Driving	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		6.5	ns				
		V _{CCB} =3.3V±0.3V		6.9	ns				
		V _{CCB} =5V±0.5V		7.2	ns				
		V _{CCB} =2.5V±0.2V	43	250	ns				
		V _{CCB} =3.3V±0.3V	36	206	ns				
		V _{CCB} =5V±0.5V	27	190	ns				
Push-Pull Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		5.3	ns				
		V _{CCB} =5V±0.5V		5.5	ns				
		V _{CCB} =3.3V±0.3V	36	204	ns				
		V _{CCB} =5V±0.5V	28	165	ns				
		Open-Drain Driving	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V		8.5	ns		
				V _{CCB} =3.3V±0.3V		8.5	ns		
V _{CCB} =5V±0.5V				8.8	ns				
V _{CCB} =2.5V±0.2V	45			260	ns				
V _{CCB} =3.3V±0.3V	36			208	ns				
V _{CCB} =5V±0.5V	27			198	ns				
Open-Drain Driving	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		6.5	ns				
		V _{CCB} =3.3V±0.3V		6.9	ns				
		V _{CCB} =5V±0.5V		7.2	ns				
		V _{CCB} =2.5V±0.2V	43	250	ns				
		V _{CCB} =3.3V±0.3V	36	206	ns				
		V _{CCB} =5V±0.5V	27	190	ns				
Push-Pull Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		5.3	ns				
		V _{CCB} =5V±0.5V		5.5	ns				
		V _{CCB} =3.3V±0.3V	36	204	ns				
		V _{CCB} =5V±0.5V	28	165	ns				
		Open-Drain Driving	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V		8.5	ns		
				V _{CCB} =3.3V±0.3V		8.5	ns		
V _{CCB} =5V±0.5V				8.8	ns				
V _{CCB} =2.5V±0.2V	45			260	ns				
V _{CCB} =3.3V±0.3V	36			208	ns				
V _{CCB} =5V±0.5V	27			198	ns				
Open-Drain Driving	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		6.5	ns				
		V _{CCB} =3.3V±0.3V		6.9	ns				
		V _{CCB} =5V±0.5V		7.2	ns				
		V _{CCB} =2.5V±0.2V	43	250	ns				
		V _{CCB} =3.3V±0.3V	36	206	ns				
		V _{CCB} =5V±0.5V	27	190	ns				
Push-Pull Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		5.3	ns				
		V _{CCB} =5V±0.5V		5.5	ns				
		V _{CCB} =3.3V±0.3V	36	204	ns				
		V _{CCB} =5V±0.5V	28	165	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} =1.8V±0.15V	V _{CCB} =2.5V±0.2V			7.5	ns
				V _{CCB} =3.3V±0.3V			5.7	ns
				V _{CCB} =5V±0.5V			2.7	ns
	V _{CCB} =2.5V±0.2V			45		175	ns	
	V _{CCB} =3.3V±0.3V			36		140	ns	
	V _{CCB} =5V±0.5V			27		102	ns	
	Open-Drain Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V			4.3	ns
				V _{CCB} =3.3V±0.3V			3.0	ns
				V _{CCB} =5V±0.5V			1.7	ns
				V _{CCB} =2.5V±0.2V	44		170	ns
				V _{CCB} =3.3V±0.3V	37		140	ns
				V _{CCB} =5V±0.5V	27		103	ns
	Push-Pull Driving		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V			4.3	ns
				V _{CCB} =5V±0.5V			4.5	ns
				V _{CCB} =3.3V±0.3V	3		139	ns
	V _{CCB} =5V±0.5V			3		105	ns	
	Open-Drain Driving			V _{CCB} =2.5V±0.2V			450	ns
				V _{CCB} =3.3V±0.3V			200	ns
V _{CCB} =5V±0.5V					200	ns		
Enable Time From Input (OE) to Output (A or B)	t _{en}	V _{CCA} =1.8V±0.15V		V _{CCB} =2.5V±0.2V			200	ns
				V _{CCB} =3.3V±0.3V			200	ns
			V _{CCB} =5V±0.5V			200	ns	
		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V			200	ns	
			V _{CCB} =3.3V±0.3V			200	ns	
			V _{CCB} =5V±0.5V			200	ns	
Disable Time From Input (OE) to Output (A or B)	t _{dis}	V _{CCA} =1.8V±0.15V	V _{CCB} =3.3V±0.3V			200	ns	
			V _{CCB} =5V±0.5V			200	ns	
			V _{CCB} =2.5V±0.2V			50	ns	
		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V			40	ns	
			V _{CCB} =3.3V±0.3V			35	ns	
			V _{CCB} =5V±0.5V			50	ns	
Input Rise Time (A Port Rise Time)	Push-Pull Driving	t _{rA}	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	3.2		11.9	ns
				V _{CCB} =3.3V±0.3V	2.3		11.7	ns
				V _{CCB} =5V±0.5V	2		9.5	ns
	V _{CCB} =2.5V±0.2V			38		165	ns	
	V _{CCB} =3.3V±0.3V			30		132	ns	
	V _{CCB} =5V±0.5V			22		95	ns	
	Open-Drain Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V	2.8		9.3	ns
				V _{CCB} =3.3V±0.3V	2.6		8.3	ns
				V _{CCB} =5V±0.5V	1.8		7.8	ns
				V _{CCB} =2.5V±0.2V	34		149	ns
				V _{CCB} =3.3V±0.3V	28		121	ns
				V _{CCB} =5V±0.5V	24		89	ns
Push-Pull Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V	2.3		7.0	ns		
		V _{CCB} =5V±0.5V	1.9		7.4	ns		
		V _{CCB} =3.3V±0.3V	25		116	ns		
V _{CCB} =5V±0.5V		19		85	ns			

■ SWITCHING CHARACTERISTICS (Cont.)

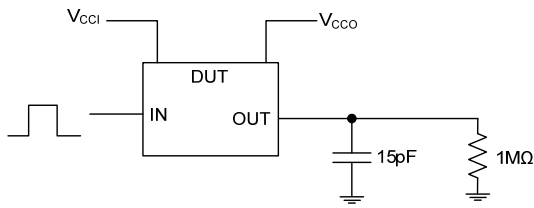
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Input Rise Time (B Port Rise Time)	Push-Pull Driving	t _{rB}	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	3.3		13.5	ns
				V _{CCB} =3.3V±0.3V	2.7		11.4	ns
				V _{CCB} =5V±0.5V	2.7		9.5	ns
	Open-Drain Driving			V _{CCB} =2.5V±0.2V	34		145	ns
				V _{CCB} =3.3V±0.3V	23		106	ns
				V _{CCB} =5V±0.5V	10		58	ns
	Push-Pull Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V	3.2		10.4	ns
				V _{CCB} =3.3V±0.3V	2.9		9.7	ns
				V _{CCB} =5V±0.5V	2.4		8.3	ns
	Open-Drain Driving			V _{CCB} =2.5V±0.2V	35		151	ns
				V _{CCB} =3.3V±0.3V	24		112	ns
				V _{CCB} =5V±0.5V	12		64	ns
	Push-Pull Driving		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V	2.5		8.0	ns
				V _{CCB} =5V±0.5V	2.1		9.3	ns
				Open-Drain Driving	V _{CCB} =3.3V±0.3V	26		116
	V _{CCB} =5V±0.5V				26		116	ns
	V _{CCB} =5V±0.5V				26		116	ns
	Input Fall Time (A Port Fall Time)			Push-Pull Driving	t _{fA}	V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	2
V _{CCB} =3.3V±0.3V		1.9					7.5	ns
V _{CCB} =5V±0.5V		1.7					16.7	ns
Open-Drain Driving		V _{CCB} =2.5V±0.2V	4.4				6.9	ns
		V _{CCB} =3.3V±0.3V	4.3				6.4	ns
		V _{CCB} =5V±0.5V	4.2				6.1	ns
Push-Pull Driving		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V	1.9			7.2	ns
			V _{CCB} =3.3V±0.3V	1.9			6.9	ns
			V _{CCB} =5V±0.5V	1.8			6.7	ns
Open-Drain Driving			V _{CCB} =2.5V±0.2V	4.4			6.9	ns
			V _{CCB} =3.3V±0.3V	4.3			6.2	ns
			V _{CCB} =5V±0.5V	4.2			5.8	ns
Push-Pull Driving		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V	2			6.8	ns
			V _{CCB} =5V±0.5V	1.9			6.3	ns
			Open-Drain Driving	V _{CCB} =3.3V±0.3V		4.3		6.1
V _{CCB} =5V±0.5V				4.2			5.7	ns
V _{CCB} =5V±0.5V				4.2			5.7	ns
Input Fall Time (B Port Fall Time)			Push-Pull Driving	t _{rB}		V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	2.0
	V _{CCB} =3.3V±0.3V	1.9					9.4	ns
	V _{CCB} =5V±0.5V	1.7					12.5	ns
	Open-Drain Driving	V _{CCB} =2.5V±0.2V	5.9				13.8	ns
		V _{CCB} =3.3V±0.3V	6.5				16.2	ns
		V _{CCB} =5V±0.5V	5.7				16.2	ns
	Push-Pull Driving	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V		2.2		9.8	ns
			V _{CCB} =3.3V±0.3V		2.4		8.4	ns
			V _{CCB} =5V±0.5V		2.6		8.3	ns
	Open-Drain Driving		V _{CCB} =2.5V±0.2V		5.1		8.8	ns
			V _{CCB} =3.3V±0.3V		5.4		9.4	ns
			V _{CCB} =5V±0.5V		5.4		10.4	ns
	Push-Pull Driving	V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V		2.3		9.3	ns
			V _{CCB} =5V±0.5V		2.4		9.5	ns
			Open-Drain Driving		V _{CCB} =3.3V±0.3V	5		7.6
	V _{CCB} =5V±0.5V				4.8		8.3	ns
	V _{CCB} =5V±0.5V				4.8		8.3	ns

■ SWITCHING CHARACTERISTICS (Cont.)

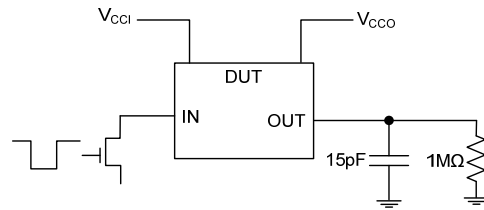
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Data Rate	Push-Pull Driving	f_{data}	$V_{CCA}=1.65V\sim 2.7V,$ $V_{CCB}=2.3V\sim 5.5V$			24	Mbps
			$V_{CCA}=3V\sim 3.6V, V_{CCB}=3.6V\sim 5.5V$			24	Mbps
	Open-Drain Driving		$V_{CCA}=1.65V\sim 2.7V,$ $V_{CCB}=2.3V\sim 5.5V$			2	Mbps
			$V_{CCA}=3V\sim 3.6V, V_{CCB}=3.6V\sim 5.5V$			2	Mbps
Pulse Duration	Push-Pull Driving	t_w	$V_{CCA}=1.65V\sim 2.7V,$ $V_{CCB}=2.3V\sim 5.5V$	41			ns
			$V_{CCA}=3V\sim 3.6V, V_{CCB}=3.6V\sim 5.5V$	41			ns
	Open-Drain Driving		$V_{CCA}=1.65V\sim 2.7V,$ $V_{CCB}=2.3V\sim 5.5V$	500			ns
			$V_{CCA}=3V\sim 3.6V, V_{CCB}=3.6V\sim 5.5V$	500			ns

TEST CIRCUIT AND WAVEFORMS

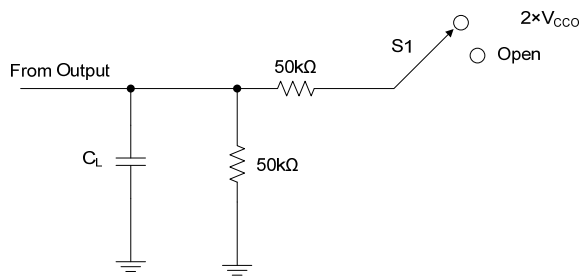
Load Circuits



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

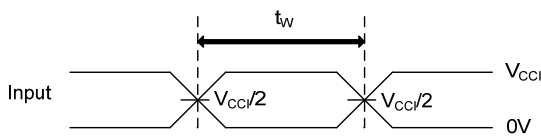


Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using an Open-Drain Driver

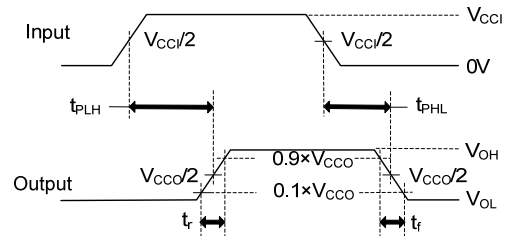


TEST	S1
t_{PLZ}/t_{PZL}	$2 \times V_{CCO}$
t_{PHZ}/t_{PZH}	Open

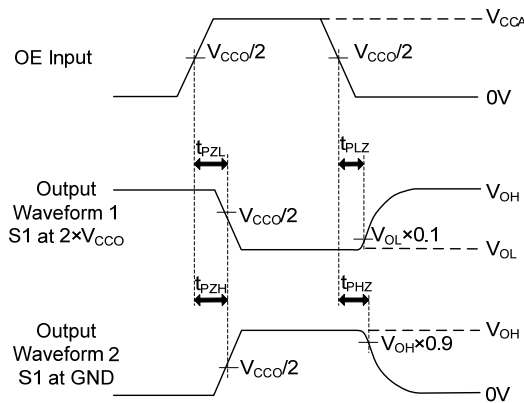
- Notes: 1. C_L includes probe and jig capacitance.
- 2. t_{en} is the same as t_{PZL} and t_{PZH} .
 t_{dis} is the same as t_{PLZ} and t_{PHZ} .
- 3. V_{CCi} is the supply voltage associated with the input.
- 4. V_{CCO} is the supply voltage associated with the output.



PULSE DURATION



PROPAGATION DELAY TIMES



ENABLE AND DISABLE TIMES

■ DETAILED DESCRIPTION

Overview

The **UTXS0104** device is a directionless voltage-level translator specifically designed for translating logic voltage levels. The A port is able to accept I/O voltages ranging from 1.65V to 3.6V, while the B port can accept I/O voltages from 2.3V to 5.5V. The device is a pass gate architecture with edge rate accelerators (one shots) to improve the overall data rate. 10k Ω pull-up resistors, commonly used in open-drain applications, have been conveniently integrated so that an external resistor is not needed. While this device is designed for open-drain applications, the device can also translate push-pull CMOS logic outputs.

Architecture

The **UTXS0104** architecture does not require a direction-control signal to control the direction of data flow from A to B or from B to A.

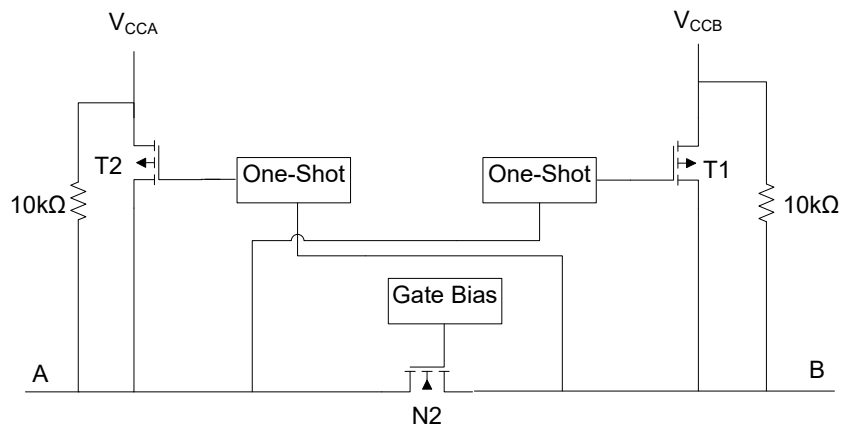


Figure 1. Architecture of UTXB0101 I/O Cell

Each A-port I/O has an internal 10k Ω pull up resistor to V_{CCA} , and each B-port I/O has an internal 10k Ω pull-up resistor to V_{CCB} . The output one-shots detect rising edges on the A or B ports. During a rising edge, the one-shot turns on the PMOS transistors (T1, T2) for a short duration, which speeds up the low-to-high transition.

Input Driver Requirements

The fall time (t_{fA} , t_{fB}) of a signal depends on the output impedance of the external device driving the data I/Os of the **UTXS0104**. Similarly, the t_{PHL} and max data rates also depend on the output impedance of the external driver. The values for t_{fA} , t_{fB} , t_{PHL} , and maximum data rates in the data sheet assume that the output impedance of the external driver is less than 50 Ω .

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 **UTXS0104** 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.

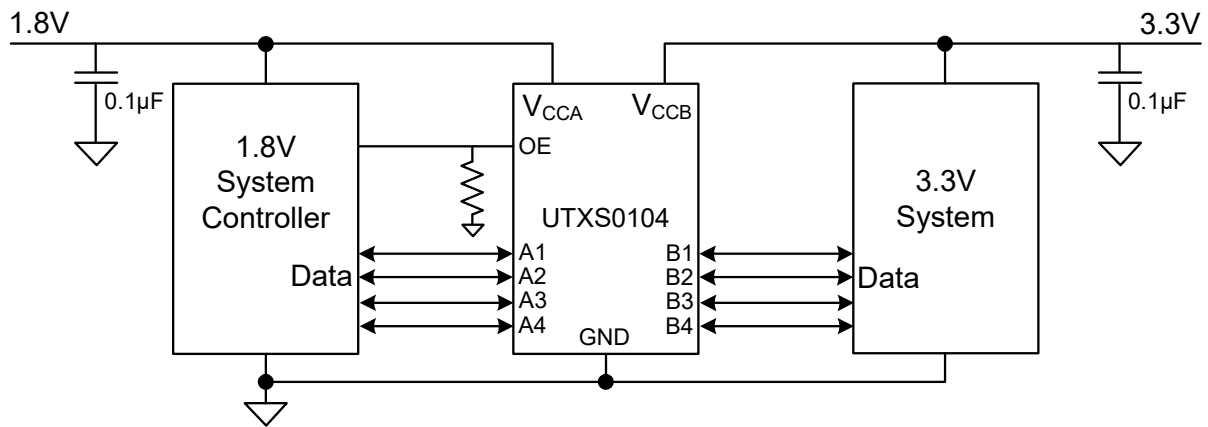
Pull-up or Pull-down Resistors on I/O Lines

Each A-port I/O has an internal 10k Ω pull-up resistor to V_{CCA} , and each B-port I/O has an internal 10 k Ω pull-up resistor to V_{CCB} . If a smaller value of pull-up resistor is required, an external resistor must be added from the I/O to V_{CCA} or V_{CCB} (in parallel with the internal 10 k Ω resistors).

Device Functional Modes

The **UTXS0104** device has two functional modes, enabled and disabled. To disable the device set the OE input low, which places all I/Os in a high impedance state. Setting the OE input high will enable the device.

■ TYPICAL APPLICATION CIRCUIT



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