

UTXS0104 Preliminary CMOS IC

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



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 $V_{\rm CCA}$. $V_{\rm CCA}$ accepts any supply voltage from 1.65V to 3.6V.The B port is designed to track $V_{\rm CCB}$. $V_{\rm CCA}$ must be less than or equal to $V_{\rm CCB}$. $V_{\rm CCB}$ 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 $V_{\text{CCA}}.$

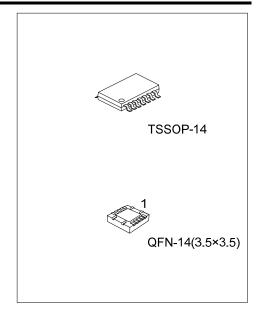
To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pull-down resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

■ FEATURES

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

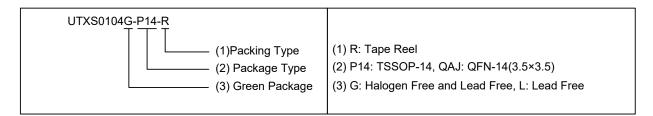
APPLICATION

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

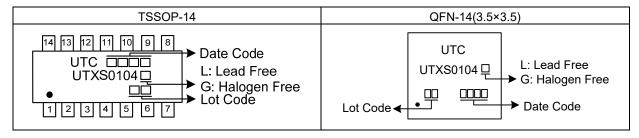


■ ORDERING INFORMATION

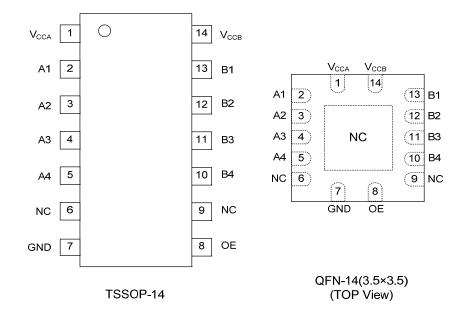
Ordering	Number	Dealters	Dealine
Lead Free	Halogen Free	Package	Packing
UTXS0104L-P14-R	UTXS0104G-P14-R	TSSOP-14	Tape Reel
UTXS0104L-QAJ-R	UTXS0104G-QAJ-R	QFN-14(3.5×3.5)	Tape Reel



MARKING



■ PIN CONFIGURATION



■ PIN DESCRIPTION

Р	IN NO.		1/0	DECORIDATION
TSSOP-14	QFN-14(3.5×3.5)	PIN NAME	I/O	DESCRIPTION
1	1	Vcca		A-port supply voltage 1.65V ≤ V _{CCA} ≤ 3.6V and V _{CCA} ≤ V _{CCB} .
2	2	A1	I/O	Input/output A1. Referenced to V _{CCA}
3	3	A2	I/O	Input/output A2. Referenced to V _{CCA}
4	4	A3	I/O	Input/output A3. Referenced to V _{CCA}
5	5	A4	I/O	Input/output A4. Referenced to V _{CCA}
6	6	NC		No connection. Not internally connected.
7	7	GND		Ground
8	8	OE	1	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	10	B4	I/O	Input/output B4. Referenced to V _{CCB}
11	11	B3	I/O	Input/output B3. Referenced to V _{CCB}
12	12	B2	I/O	Input/output B2. Referenced to V _{CCB}
13	13	B1	I/O	Input/output B1. Referenced to V _{CCB}
14	14	V _{CCB}		B-port supply voltage 2.3V ≤ V _{CCB} ≤ 5.5V
-	Exposed Pad	NC		Thermal pad

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

■ FUNCTION TABLE

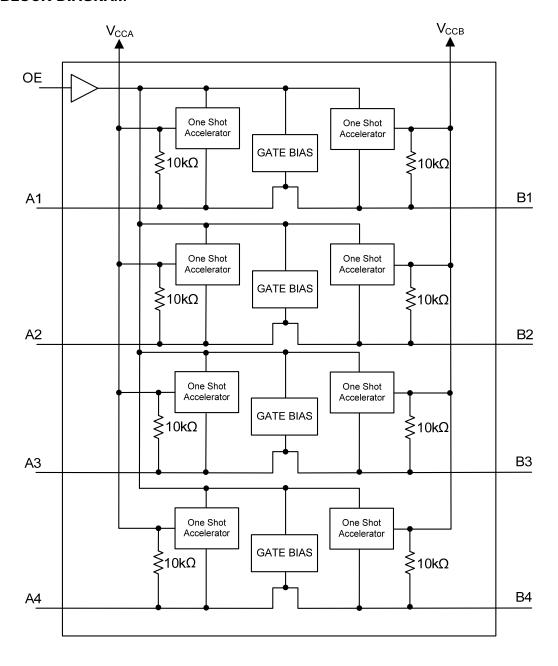
SUPPLY	SUPPLY VOLTAGE		INPUT/0	DUTPUT
V_{CCA}	V _{CCB}	OE	An	Bn
1.65V ~ V _{CCB}	2.3V ~ 5.5V	L	Z	Z
1.65V ~ V _{CCB}	2.3V ~ 5.5V	Н	Input or Output	Output or Input
GND	GND	X	Z	Z

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
lament Valtage	A Port	V	-0.5 ~ 4.6	V
Input Voltage	B Port	V_{IN}	-0.5 ~ 6.5	V
Voltage Range Applied to Any	A Port		-0.5 ~ 4.6	V
Output In the High-Impedance or Power-Off State B Port		V _{OUT}	-0.5 ~ 6.5	V
Voltage Range Applied to Any	A Port		-0.5 ~ V _{CCA} +0.5	V
Output In the High or Low State	B Port	V _{OUT}	-0.5 ~ V _{CCB} +0.5	V
Input Clamp Current	V _{IN} <0	I _{IK}	-50	mA
Output Clamp Current	V _{OUT} <0	lok	-50	mA
Continuous Output Current		I _{OUT}	±50	mA
Continuous Current Through V _{CCA} ,	Continuous Current Through V _{CCA} , V _{CCB} , or 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)		Vcca		1.65		3.6	V
Supply Voltage (Note 3)		V _{CCB}		2.3		5.5	V
Input Voltage		VIN		0		Vccı	V
Output Valtage	A Port I/Os	\/	V _{CCA} =1.65V~3.6V,	0		3.6	V
Output Voltage	B Port I/Os	Vout	V _{CCB} =2.3V~5.5V	0		5.5	V
			V _{CCA} =1.65V~1.95V,	V _{CCI} -		Vccı	V
	A Port I/Os		V _{CCB} =2.3V~5.5V	0.2		V CCI	V
	A FULLIOS		V _{CCA} =2.3V~3.6V,	Vccı-		Vccı	V
High-Level Input Voltage		ViH	V _{CCB} =2.3V~5.5V	0.4		V CCI	V
i ligii-Level liiput voltage	B Port I/Os	VIH		Vccı-		Vccı	V
	B T OIT I/OS		V _{CCA} =1.65V~3.6V,	0.4		V CCI	V
	OE Input		V _{CCB} =2.3V~5.5V	Vcca		5.5	V
	OL IIIput			×0.65		0.0	V
	A Port I/Os			0		0.15	V
Low-Level Input Voltage	B Port I/Os	VıL	V _{CCA} =1.65V~3.6V,	0		0.15	V
Low-Level Input Voltage	OE Input	VIL	V _{CCB} =2.3V~5.5V	0		Vcca	V
	OE Iliput			U		×0.35	V
Input Transition Disc or	A Port I/Os		Vac. = 1 65 Va 2 6 V			10	ns/V
Input Transition Rise or Fall Rate	B Port I/Os	Δt/Δν	V _{CCA} =1.65V~3.6V, V _{CCB} =2.3V~5.5V			10	ns/V
rali Nale	OE Input		VCCB-2.3V~3.3V			10	ns/V
Operating Temperature		TA		-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	र	SYMBOL	TEST C	CONDITIONS	MIN	TYP	MAX	UNIT
Port A Output High Voltag	e	V _{ОНА}	$V_{CCA}=1.65V\sim3$ $V_{CCB}=2.3V\sim5.5$ $V_{IB} \ge V_{CCB}=0.4$	5V, I _{OH} =-20μA,	V _{CCA} ×0.8			٧
Port A Output Low Voltage	•	V _{OLA}	V_{CCA} =1.65V~3.6V, V_{CCB} =2.3V~5.5V, I_{OL} =1mA, $V_{IB} \le 0.15V$				0.4	V
Port B Output High Voltag	e	V _{ОНВ}	$V_{CCA}=1.65V\sim3$ $V_{CCB}=2.3V\sim5.8$ $V_{IA} \ge V_{CCA}=0.2$	5V, I _{OH} =-20μA	V _{CCB} ×0.8			>
Port B Output Low Voltage)	V _{OLB}	$V_{CCA}=1.65V\sim3$ $V_{CCB}=2.3V\sim5.5$ $V_{IA} \le 0.15V$	•			0.4	٧
Input Leakage Current	OE	I _{I(LEAK)}	V _{CCA} =1.65V~3 V _{CCB} =2.3V~5.5	•	-1		1	μΑ
High-Impedance State Output Current	A or B Port	l _{OZ}	V _{CCA} =1.65V~3 V _{CCB} =2.3V~5.5	•	-1		1	μΑ
				V _{CCA} =1.65V~V _{CCB} , V _{CCB} =2.3V~5.5V			2.4	μΑ
		ICCA		V _{CCA} =3.6V, V _{CCB} =0V			2.2	μΑ
				V _{CCA} =0V, V _{CCB} =5.5V			-1	μΑ
Supply Current			V _I =V _O =Open, I _O =0A	V _{CCA} =1.65V~V _{CCB} , V _{CCB} =2.3V~5.5V			12	μΑ
		Іссв		V _{CCA} =3.6V, V _{CCB} =0V			-1	μΑ
				V _{CCA} =0V, V _{CCB} =5.5V			1	μΑ
		ICCA+ICCB		V _{CCA} =1.65V~V _{CCB} , V _{CCB} =2.3V~5.5V			14.4	μΑ
Input Capacitance	OE	Cin				2.5		pF
Output Capacitance	A Port	Cıo	V _{CCA} =3.3V, V _{CCB} =3.3V			5		pF
Catput Capacitance	B Port	Oio				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 CC	ONDITIONS	MIN	TYP	MAX	UNIT
	Decelo Deall			V _{CCB} =2.5V±0.2V			5.8	ns
	Push-Pull			V _{CCB} =3.3V±0.3V			5.9	ns
	Driving		1 0 4 0 4 5 4	V _{CCB} =5V±0.5V			7.3	ns
	On an Drain		V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	2.9		8.8	ns
	Open-Drain Driving			V _{CCB} =3.3V±0.3V	2.9		9.6	ns
	Driving			V _{CCB} =5V±0.5V	3		10	ns
	Push-Pull			V _{CCB} =2.5V±0.2V			4.0	ns
Propagation Delay	Driving			V _{CCB} =3.3V±0.3V			4.2	ns
From Input (A) to Output (B)	Driving		\/ =0.5\/.0.0\/	V _{CCB} =5V±0.5V			4.3	ns
	Open Drain		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V	1.7		6.3	ns
	Open-Drain Driving			V _{CCB} =3.3V±0.3V	2		6.0	ns
	Driving			V _{CCB} =5V±0.5V	2.1		5.8	ns
	Push-Pull			V _{CCB} =3.3V±0.3V			3.0	ns
	Driving		V _{CCA} =3.3V±0.3V	V _{CCB} =5V±0.5V			3.9	ns
	Open-Drain		VCCA-3.3V±0.3V	V _{CCB} =3.3V±0.3V	1.3		4.2	ns
	Driving	t		V _{CCB} =5V±0.5V	1.4		4.6	ns
	Push-Pull	t _{PHL}		V _{CCB} =2.5V±0.2V			5.5	ns
	Driving			V _{CCB} =3.3V±0.3V			5.7	ns
	Driving		V _{CCA} =1.8V±0.15V	V _{CCB} =5V±0.5V			5.9	ns
	Open-Drain Driving		V _{CCA} -1.6V±0.15V	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 Open-Drain Driving			V _{CCB} =2.5V±0.2V			3.8	ns
Propagation Delay				V _{CCB} =3.3V±0.3V			4.5	ns
From Input (B) to Output (A)			V _{CCA} =2.5V±0.2V	V _{CCB} =5V±0.5V			5.4	ns
			V _{CCA} -2.3V±0.2V	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
	Push-Pull			V _{CCB} =3.3V±0.3V			3.2	ns
	Driving	_	V _{CCA} =3.3V±0.3V	V _{CCB} =5V±0.5V			4.2	ns
	Open-Drain			V _{CCB} =3.3V±0.3V	1		124	ns
	Driving			V _{CCB} =5V±0.5V	1		97	ns
	Push-Pull			V _{CCB} =2.5V±0.2V			8.5	ns
	Driving			V _{CCB} =3.3V±0.3V			8.5	ns
	Diving		V _{CCA} =1.8V±0.15V	V _{CCB} =5V±0.5V			8.8	ns
	Open-Drain		VCCA-1.0V±0.10V	V _{CCB} =2.5V±0.2V	45		260	ns
	Driving			V _{CCB} =3.3V±0.3V	36		208	ns
Propagation Delay From Input (A) to Output (B)	Diving			V _{CCB} =5V±0.5V	27		198	ns
	Push-Pull			V _{CCB} =2.5V±0.2V			6.5	ns
	Driving	tplH		V _{CCB} =3.3V±0.3V			6.9	ns
		4F°L∏	V _{CCA} =2.5V±0.2V	V _{CCB} =5V±0.5V			7.2	ns
	Open-Drain		- CCA 2.0 V ±0.2 V	V _{CCB} =2.5V±0.2V	43		250	ns
	Driving			V _{CCB} =3.3V±0.3V	36		206	ns
				V _{CCB} =5V±0.5V	27		190	ns
	Push-Pull			V _{CCB} =3.3V±0.3V			5.3	ns
	Driving	1	V _{CCA} =3.3V±0.3V	V _{CCB} =5V±0.5V			5.5	ns
C	Open-Drain		-	V _{CCB} =3.3V±0.3V	36		204	ns
	Driving]		V _{CCB} =5V±0.5V	28		165	ns

■ SWITCHING CHARACTERISTICS (Cont.)

Push-Pull Driving Push	PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Driving Open-Drain Driving		D 1 D 11			V _{CCB} =2.5V±0.2V			7.5	ns
Propagation Delay Propagation					V _{CCB} =3.3V±0.3V				ns
Open-Drain Driving Push-Pull Driving Open-Drain Driving Open-Drain Driving Open-Drain Driving Open-Drain Driving Open-Drain Orion Open-Drain Ope		Driving			V _{CCB} =5V±0.5V			2.7	ns
Propagation Delay Propagation Delay From Input (B) to Output (A) Push-Pull Driving Push-Pull Open-Drain Driving Push-Pull Driving Disable Time From Input (OE) to Output (A or B) Idas Push-Pull Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Push-Pull Driving Open-Drain Driving Op		0 5 :		V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	45		175	ns
Propagation Delay Push-Pull Driving		1 .			V _{CCB} =3.3V±0.3V	36		140	ns
Propagation Delay From Input (B) to Output (A) Driving Push-Pull Driving Push-		Driving			V _{CCB} =5V±0.5V	27		102	ns
Propagation Delay Propagation Delay Propagation Delay Promiting Promiting Push-Pull Driving Push-Pull Push-Pull Push-Pull Driving		Duck Dull			V _{CCB} =2.5V±0.2V			4.3	ns
Promitiput (B) to Output (A) Promiting Push-Pull Driving P	Propagation Delay		tou		V _{CCB} =3.3V±0.3V			3.0	ns
Open-Drain Driving	From Input (B) to Output (A)	Driving	IPLH	\/ =2.5\/±0.2\/	V _{CCB} =5V±0.5V			1.7	ns
Driving Push-Pull Driving Push-Pull Driving Push-Pull Driving Open-Drain Driving Open-Drain Driving Open-Drain Driving Open-Drain O		Opon Drain		VCCA-2.3V10.2V	V _{CCB} =2.5V±0.2V	44		170	ns
Push-Pull Driving Push-Pull Driving Voca=3.3V±0.3V					V _{CCB} =3.3V±0.3V	37		140	ns
Driving Open-Drain Oriving Vcca=3.3V±0.5V Vcca=3.3V±0.5V Vcca=3.3V±0.5V Vcca=5V±0.5V A 105 ns Vcca=3.3V±0.3V A 105 ns Vcca=3.3V±0.3V A 105 ns Vcca=3.3V±0.3V A 105 ns Vcca=3.3V±0.3V A 105 ns Vcca=5V±0.5V A 105 ns Vcca=3.3V±0.3V A 105 ns Vcca=5V±0.5V A 105 ns Vc		Driving			V _{CCB} =5V±0.5V	27		103	ns
Open-Drain Driving V _{CCA} =3.3V±0.3V V _{CCB} =3.3V±0.3V 3 139 ns V _{CCB} =2.5V±0.5V 3 105 ns V _{CCB} =2.5V±0.5V 3 105 ns V _{CCB} =2.5V±0.2V 450 ns V _{CCB} =3.3V±0.3V V _{CCB} =3.3V±0.3V V _{CCB} =3.3V±0.3V V _{CCB} =3.3V±0.3V V _{CCB} =5.5V±0.5V 200 ns V _{CCB} =5.5V±0.5V V _{CCB} =3.3V±0.3V V _{CCB} =5.5V±0.5V V _{CCCB} =5.5V±0.5V V _{CCB} =5.5V±0.5		Push-Pull			V _{CCB} =3.3V±0.3V			4.3	ns
Open-Drain Driving Vccs=3.9V±0.3V 3 139 ns 105 ns Vccs=2.5V±0.2V 450 ns Vccs=2.5V±0.5V 200 ns Vccs=2.5V±0.5V 200 ns Vccs=2.5V±0.5V 200 ns Vccs=2.5V±0.5V 200 ns Vccs=3.3V±0.3V V		Driving		\/=3 3\/+0 3\/	V _{CCB} =5V±0.5V			4.5	ns
Enable Time From Input (OE) to Output (A or B) ten V _{CCA} =1.8V±0.15V V _{CCA} =2.5V±0.2V V _{CCB} =2.5V±0.2V V _{CCB} =3.3V±0.3V V _{CCB} =2.5V±0.2V V _{CCB} =3.3V±0.3V V _{CCB} =5.5V±0.5V Disable Time From Input (OE) to Output (A or B) tdis V _{CCA} =1.8V±0.15V V _{CCA} =3.3V±0.3V V _{CCB} =5.5V±0.5V Disable Time From Input (OE) to Output (A or B) tdis V _{CCA} =1.8V±0.15V V _{CCA} =3.3V±0.3V V _{CCB} =5.5V±0.5V Disable Time From Input (OE) to Output (A or B) tdis V _{CCA} =1.8V±0.15V V _{CCB} =3.3V±0.3V V _{CCB} =3.3V±0.3V V _{CCB} =5.5V±0.5V Disable Time From Input (OE) to Output (A or B) tdis V _{CCA} =1.8V±0.15V V _{CCB} =5.5V±0.5V Doen-Drain Driving Den-Drain Driving V _{CCA} =3.3V±0.3V V _{CCB} =3.3V±0.3V Disable Time From Input (OE) to Output (A or B) tdis V _{CCB} =3.3V±0.3V V		Open-Drain		VCCA-3.3V±0.3V	V _{CCB} =3.3V±0.3V	3		139	ns
Enable Time From Input (OE) to Output (A or B) ten ten ten ten ten ten ten te		Driving			V _{CCB} =5V±0.5V	3		105	ns
Enable Time From Input (OE) to Output (A or B) ten Vcca=2.5V±0.2V Vcca=3.3V±0.3V Vcca=3.3V±0.3V Vcca=3.3V±0.3V Vcca=3.3V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V Vcca=5V±0.5V Vcca=3.3V±0.3V					V _{CCB} =2.5V±0.2V				ns
Enable Time From Input (OE) to Output (A or B) ten V _{CCA} =2.5V±0.2V V _{CCA} =3.3V±0.3V V _{CCB} =5V±0.5V V _{CCB} =3.3V±0.3V V _{CCB} =3.3V±0.5V V _{CCB} =3.3V±0.5V V _{CCB} =3.3V±0.5V V _{CCB} =5.5V±0.5V V _{CCB} =5.5V±0.					V _{CCB} =3.3V±0.3V			200	ns
From Input (OE) to Output (A or B) Voca=2.5V±0.2V Voca=3.3V±0.3V Voca=5V±0.5V Voca=5V±0									ns
Variable		or B)		V _{CCA} =2.5V±0.2V					ns
Note	From Input (OE) to Output (A								ns
Disable Time Push-Pull Driving Push-Pull									ns
Disable Time Trans Push-Pull Driving Vcca=3.3V±0.3V Vcca=3.3V±0.3V 2.3 7.0 ns Vcca=3.3V±0.3V				V _{CCA} =3.3V±0.3V					ns
Disable Time Trom Input (OE) to Output (A or B) Trom Input (OE) to Output									
Disable Time Trom Input (OE) to Output (A or B) Trom Input (OE) to Output (OE) to				V _{CCA} =1.8V±0.15V					
Disable Time From Input (OE) to Output (A or B) $t_{dis} = V_{CCA} = 2.5V \pm 0.2V $									
From Input (OE) to Output (A or B) Variable				V _{CCA} =2.5V±0.2V					
VCCB		D)							
Variable	From Input (OE) to Output (A	or B)							
Push-Pull Driving V _{CCA} =3.3V±0.3V V _{CCB} =5V±0.5V 3.5 ns Ns V _{CCB} =2.5V±0.2V 3.2 11.9 ns V _{CCB} =3.3V±0.3V 2.3 11.7 ns V _{CCB} =5.5V±0.5V 2 9.5 ns V _{CCB} =2.5V±0.5V 2 9.5 ns V _{CCB} =3.3V±0.3V 30 132 ns V _{CCB} =3.3V±0.3V 30 132 ns V _{CCB} =5.5V±0.5V 22 95 ns V _{CCB} =5.5V±0.5V 22 95 ns V _{CCB} =5.5V±0.5V 22 95 ns V _{CCB} =3.3V±0.3V 2.6 8.3 ns V _{CCB} =3.3V±0.3V 2.6 8.3 ns V _{CCB} =3.3V±0.3V 2.6 8.3 ns V _{CCB} =3.3V±0.3V 2.6 2.6 3.3 ns V _{CCB} =3.3V±0.3V 2.6 3.3									
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Push-Pull Driving V _{CCA} =1.8V±0.15V 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 V _{CCB} =2.5V±0.2V 2.8 9.3 ns V _{CCB} =3.3V±0.3V 2.6 8.3 ns Ns V _{CCB} =2.5V±0.5V 1.8 7.8 ns V _{CCB} =2.5V±0.5V 1.8 V _{CCB} =3.3V±0.3V 2.6 121 ns V _{CCB} =3.3V±0.3V 2.8 121 ns V _{CCB} =5V±0.5V 2.8 9.3 ns V _{CCB} =5V±0.5V 1.8 V _{CCB} =3.3V±0.3V 2.8 121 ns V _{CCB} =5V±0.5V 2.8 9.3 ns V _{CCB} =3.3V±0.3V 2.8 121 ns V _{CCB} =5V±0.5V 2.8 3.3 ns V _{CCB} =5V±0.5V 2.8 3.3 ns V _{CCB} =5V±0.5V 3.4						2.2			
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$\begin{array}{c} \text{Dopen-Drain Driving} \\ \text{Input Rise Time} \\ \text{(A Port Rise Time)} \\ \text{Push-Pull Driving} \\ \text{Open-Drain Driving} \\ \\ Open-Drain Dri$		Driving							
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Driving Vaca		Open-Drain							
$\begin{array}{c} \text{Input Rise Time} \\ \text{(A Port Rise Time)} \end{array} \qquad \begin{array}{c} \text{Push-Pull} \\ \text{Driving} \end{array} \qquad \begin{array}{c} \text{V}_{\text{CCA}} = 2.5 \text{V} \pm 0.2 \text{V} & 2.8 & 9.3 & \text{ns} \\ \text{V}_{\text{CCB}} = 3.3 \text{V} \pm 0.3 \text{V} & 2.6 & 8.3 & \text{ns} \\ \text{V}_{\text{CCB}} = 3.3 \text{V} \pm 0.3 \text{V} & 2.6 & 8.3 & \text{ns} \\ \text{V}_{\text{CCB}} = 5.5 \text{V} \pm 0.5 \text{V} & 1.8 & 7.8 & \text{ns} \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 1.8 & 7.8 & \text{ns} \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 1.8 & 7.8 & \text{ns} \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 1.8 & 7.8 & \text{ns} \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 1.8 & 7.8 & \text{ns} \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 1.8 & 7.8 & \text{ns} \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 1.8 & 7.8 & \text{ns} \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.4 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.8 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0.5 \text{V} & 2.8 & 1.2 & 1.8 \\ \text{V}_{\text{CCB}} = 2.5 \text{V} \pm 0$	Input Rise Time (A Port Rise Time)	Driving							
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$									
$(A \ Port \ Rise \ Time) \ \ \ \ \ \ \ \ \ \ \ \ \ $									
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		Driving	t_{rA}						
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			-	V _{CCA} =2.5V±0.2V					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		-							
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Driving							
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Push-Pull							
Open-Drain V _{CCA} =3.3V±0.3V V _{CCB} =3.3V±0.3V 25 116 ns				\/ ₂₀₄ =3 3\/+0 3\/					
		_	1						
1VCCB=3V±U.3V 19 103 INS		Driving			V _{CCB} =5V±0.5V	19		85	ns

■ SWITCHING CHARACTERISTICS (Cont.)

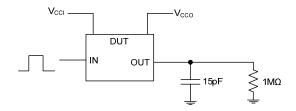
PARAMETER		SYMBOL	TEST CO	ONDITIONS	MIN	TYP	MAX	UNIT
	Push-Pull			V _{CCB} =2.5V±0.2V	3.3		13.5	ns
	Driving			V _{CCB} =3.3V±0.3V	2.7		11.4	ns
	Driving		1 0 4 0 4 5 4	V _{CCB} =5V±0.5V	2.7		9.5	ns
	O Di		V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	34		145	ns
	Open-Drain			V _{CCB} =3.3V±0.3V	23		106	ns
	Driving			V _{CCB} =5V±0.5V	10		58	ns
	Decele Deall			V _{CCB} =2.5V±0.2V	3.2		10.4	ns
Input Rise Time	Push-Pull			V _{CCB} =3.3V±0.3V	2.9		9.7	ns
(B Port Rise Time)	Driving	t _{rB}	\/ -0.5\/\0.0\/	V _{CCB} =5V±0.5V	2.4		8.3	ns
	On an Drain		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V	35		151	ns
	Open-Drain			V _{CCB} =3.3V±0.3V	24		112	ns
	Driving			V _{CCB} =5V±0.5V	12		64	ns
	Push-Pull			V _{CCB} =3.3V±0.3V	2.5		8.0	ns
	Driving		.,	V _{CCB} =5V±0.5V	2.1		9.3	ns
	Open-Drain		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V	26		116	ns
	Driving			V _{CCB} =5V±0.5V	26		116	ns
				V _{CCB} =2.5V±0.2V	2		7.4	ns
	Push-Pull			V _{CCB} =3.3V±0.3V	1.9		7.5	ns
	Driving			V _{CCB} =5V±0.5V	1.7		16.7	ns
	Open-Drain Driving	t _{fA}	V _{CCA} =1.8V±0.15V	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 _{CCB} =2.5V±0.2V	1.9		7.2	ns
Input Fall Time				V _{CCB} =3.3V±0.3V	1.9		6.9	ns
(A Port Fall Time)				V _{CCB} =5V±0.5V	1.8		6.7	ns
	Open-Drain		V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V	4.4		6.9	ns
				V _{CCB} =3.3V±0.3V	4.3		6.2	ns
	Driving			V _{CCB} =5V±0.5V	4.2		5.8	ns
	Push-Pull	1		V _{CCB} =3.3V±0.3V	2		6.8	ns
	Driving			V _{CCB} =5V±0.5V	1.9		6.3	ns
	Open-Drain	1	V _{CCA} =3.3V±0.3\	V _{CCB} =3.3V±0.3V	4.3		6.1	ns
	Driving			V _{CCB} =5V±0.5V	4.2		5.7	ns
	_			V _{CCB} =2.5V±0.2V	2.0		9.5	ns
	Push-Pull			V _{CCB} =3.3V±0.3V	1.9		9.4	ns
	Driving			V _{CCB} =5V±0.5V	1.7		12.5	ns
			V _{CCA} =1.8V±0.15V	V _{CCB} =2.5V±0.2V	5.9		13.8	ns
	Open-Drain			V _{CCB} =3.3V±0.3V	6.5		16.2	ns
Input Fall Time (B Port Fall Time) (C	Driving			V _{CCB} =5V±0.5V	5.7		16.2	ns
		1		V _{CCB} =2.5V±0.2V	2.2		9.8	ns
	Push-Pull			V _{CCB} =3.3V±0.3V	2.4		8.4	ns
	Driving	t _{fB}		V _{CCB} =5V±0.5V	2.6		8.3	ns
		1	V _{CCA} =2.5V±0.2V	V _{CCB} =2.5V±0.2V	5.1		8.8	ns
	Open-Drain			V _{CCB} =3.3V±0.3V	5.4		9.4	ns
	Driving	_		V _{CCB} =5V±0.5V	5.4		10.4	ns
	Push-Pull		V _{CCA} =3.3V±0.3V	V _{CCB} =3.3V±0.3V	2.3		9.3	ns
	Driving			V _{CCB} =5V±0.5V	2.4		9.5	ns
	Open-Drain	1		V _{CCB} =3.3V±0.3V	5		7.6	ns
	Driving			V _{CCB} =5V±0.5V	4.8		8.3	ns

■ SWITCHING CHARACTERISTICS (Cont.)

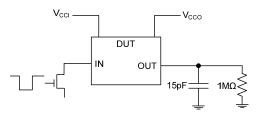
PARA	AMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT			
	Duch Dull I	Driving		V _{CCA} =1.65V~2.7V, V _{CCB} =2.3V~5.5V			24	Mbps			
Data Bata	Push-Pull I	Inving	_ f	V _{CCA} =3V~3.6V, V _{CCB} =3.6V~5.5V			24	Mbps			
Data Rate	Open Drai	o Driving		V _{CCA} =1.65V~2.7V, V _{CCB} =2.3V~5.5V			2	Mbps			
	Open-Drai	Dilving		V _{CCA} =3V~3.6V, V _{CCB} =3.6V~5.5V			2	Mbps			
	Push-Pull	Data		V _{CCA} =1.65V~2.7V, V _{CCB} =2.3V~5.5V	41			ns			
Pulse Duration	Driving	Inputs	tw	V _{CCA} =3V~3.6V, V _{CCB} =3.6V~5.5V	41			ns			
Pulse Duration	Open-Drain			V _{CCA} =1.65V~2.7V, V _{CCB} =2.3V~5.5V	500			ns			
	Driving	Inputs	inputs	inputs	nputs		V _{CCA} =3V~3.6V, V _{CCB} =3.6V~5.5V	500			ns

■ TEST CIRCUIT AND WAVEFORMS

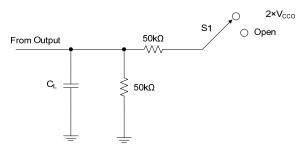
Load Circuits



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



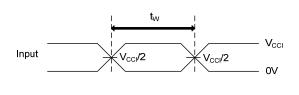
Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using an Open-Drain Driver



TEST	S1
t _{PLZ} /t _{PZL}	2×V _{cco}
t _{PHZ} /t _{PZH}	Open

Notes: 1. C_L includes probe and jig capacitance.

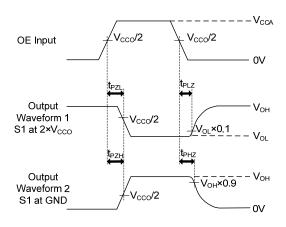
- 2. t_{en} is the same as t_{PZL} and t_{PZH} . t_{dis} is the same as t_{PLZ} and t_{PHZ} .
- 3. V_{CCI} is the supply voltage associated with the input.
- 4. V_{CCO} is the supply voltage associated with the input.



Input $V_{CC}/2$ $V_{$

PULSE DURATION

PROPAGATION DELAY TIMES



ENABLE AND DISABLE TIMES

 V_{CCI}

■ 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. $10k\Omega$ 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.

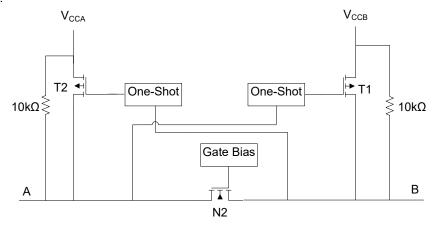


Figure 1. Architecture of UTXB0101 I/O Cell

Each A-port I/O has an internal $10k\Omega$ pull up resistor to V_{CCA} , and each B-port I/O has an internal $10k\Omega$ 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 50Ω .

Power-Up

During operation, ensure that $V_{CCA} \le V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \ge V_{CCB}$ 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.

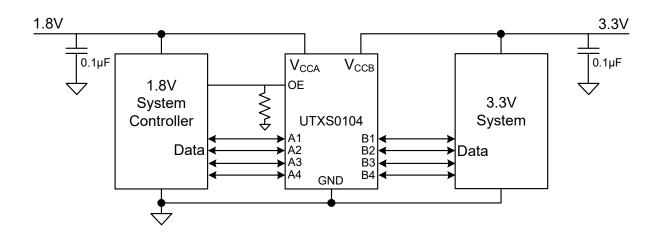
Pull-up or Pull-down Resistors on I/O Lines

Each A-port I/O has an internal $10k\Omega$ pull-up resistor to V_{CCA} , and each B-port I/O has an internal $10 k\Omega$ 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 $10 k\Omega$ 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



Preliminary

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