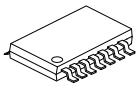
4-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR FOR OPEN-DRAIN AND PUSH-PULL APPLICATION



TSSOP-14

QFN-14(3.5×3.5)

■ 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

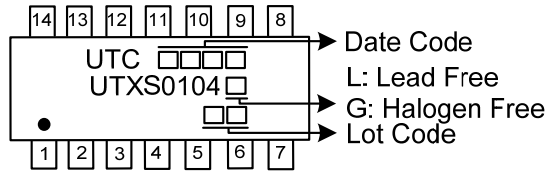
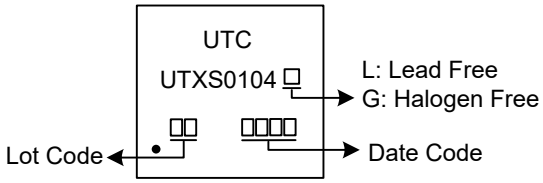
* Handset
* Smartphone
* Tablet
* Desktop PC

■ ORDERING INFORMATION

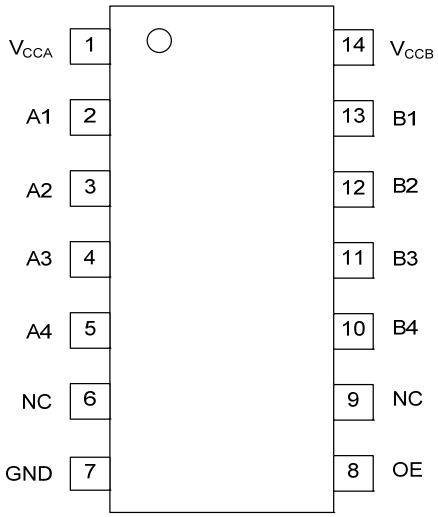
Ordering Number		Package	Packing
Lead Free	Halogen Free		
UTXS0104L-P14-R	UTXS0104G-P14-R	TSSOP-14	Tape Reel
UTXS0104L-QAJ-R	UTXS0104G-QAJ-R	QFN-14(3.5×3.5)	Tape Reel

UTXS0104G-P14-R (1)Packing Type (2) Package Type (3) Green Package	(1) R: Tape Reel (2) P14: TSSOP-14, QAJ: QFN-14(3.5×3.5) (3) G: Halogen Free and Lead Free, L: Lead Free

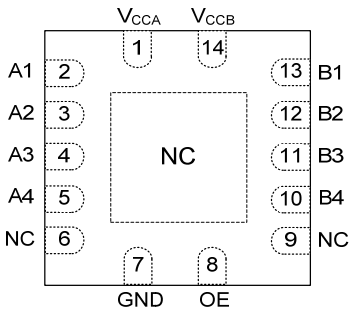
■ MARKING

TSSOP-14	QFN-14(3.5×3.5)
	

■ PIN CONFIGURATION



TSSOP-14



QFN-14(3.5×3.5)
(TOP View)

■ PIN DESCRIPTION

PIN NO.		PIN NAME	I/O	DESCRIPTION
TSSOP-14	QFN-14(3.5×3.5)			
1	1	V_{CCA}		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	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	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

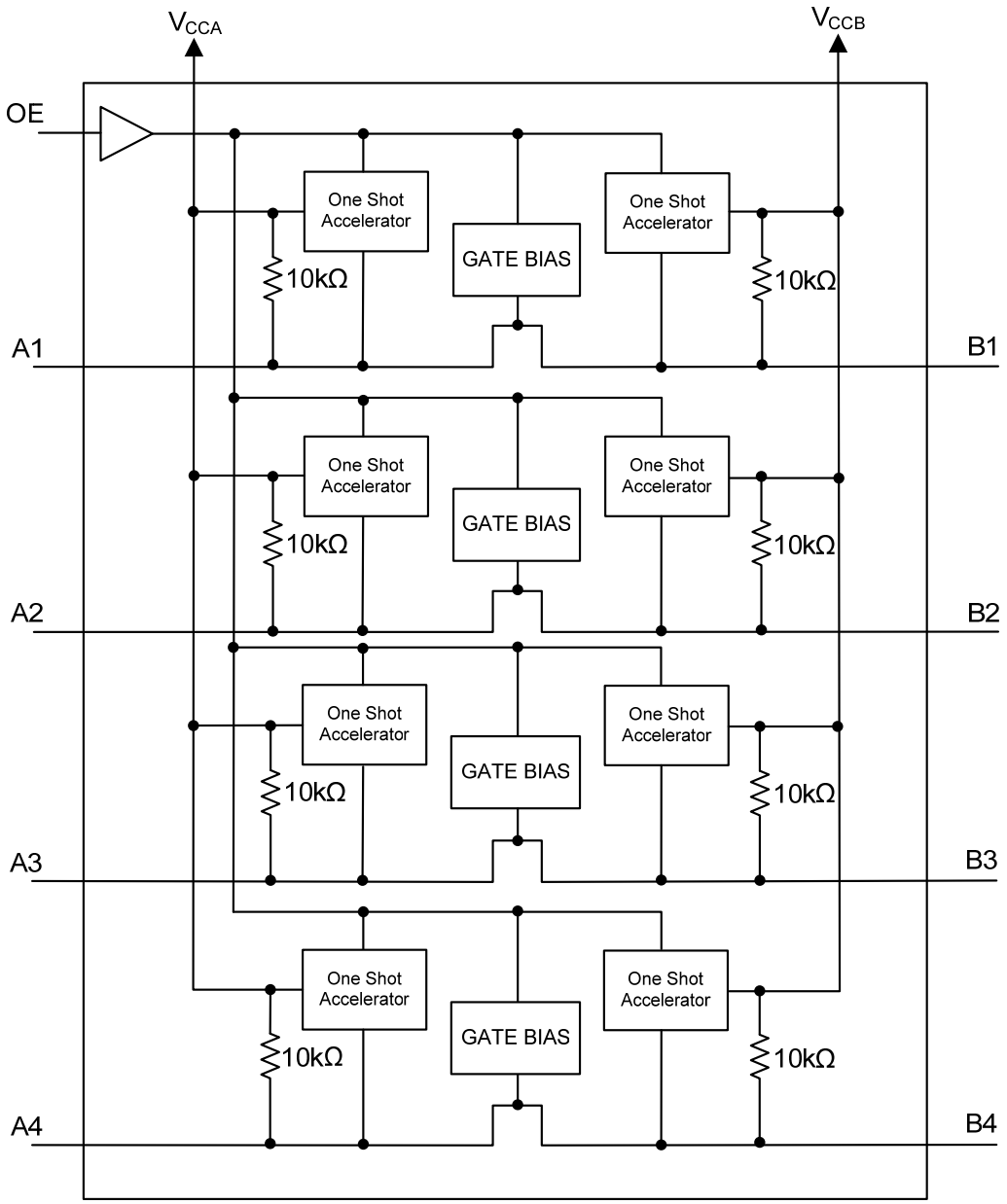
■ FUNCTION TABLE

SUPPLY VOLTAGE		INPUT	INPUT/OUTPUT	
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	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~3.6V, V_{CCB}=2.3V~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~1.95V, V_{CCB}=2.3V~5.5V	V_{CCI}-0.2		V_{CCI}	V
			V_{CCA}=2.3V~3.6V, V_{CCB}=2.3V~5.5V	V_{CCI}-0.4		V_{CCI}	V
	B Port I/Os		V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V	V_{CCI}-0.4		V_{CCI}	V
	OE Input			V_{CCA} ×0.65		5.5	V
Low-Level Input Voltage	A Port I/Os	V_{IL}	V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V	0		0.15	V
	B Port I/Os			0		0.15	V
	OE Input			0		V_{CCA} ×0.35	V
Input Transition Rise or Fall Rate	A Port I/Os	Δt/Δv	V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~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~3.6V, V_{CCB}=2.3V~5.5V, I_{OH}=-20μA, $V_{IB} \geq V_{CCB}$-0.4V		V_{CCA} ×0.8			V
Port A Output Low Voltage		V_{OLA}	V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V, I_{OL}=1mA, $V_{IB} \leq$ 0.15V				0.4	V
Port B Output High Voltage		V_{OHB}	V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V, I_{OH}=-20μA $V_{IA} \geq V_{CCA}$-0.2V		V_{CCB} ×0.8			V
Port B Output Low Voltage		V_{OLB}	V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V, I_{OL}=1mA, $V_{IA} \leq$ 0.15V				0.4	V
Input Leakage Current	OE	$I_{I(LEAK)}$	V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V		-1		1	μA
High-Impedance State Output Current	A or B Port	I_{OZ}	V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V, OE=GND		-1		1	μA
Supply Current		I_{CCA}	V_I=V_O=Open, I_O=0A	V_{CCA}=1.65V~V_{CCB}, V_{CCB}=2.3V~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~V_{CCB}, V_{CCB}=2.3V~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~V_{CCB}, V_{CCB}=2.3V~5.5V			14.4	μA
Input Capacitance	OE	C_{IN}	V_{CCA}=3.3V, V_{CCB}=3.3V			2.5		pF
Output Capacitance	A Port	C_{IO}				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
	Open-Drain Driving			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
	Push-Pull 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
	Open-Drain Driving			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
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	1.3		4.2	ns
				V_{CCB}=5V±0.5V	1.4		4.6	ns
Propagation Delay From Input (B) to Output (A)	Push-Pull 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
	Open-Drain Driving			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
	Open-Drain Driving			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 Driving		V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			3.2	ns
				V_{CCB}=5V±0.5V			4.2	ns
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	1		124	ns
				V_{CCB}=5V±0.5V	1		97	ns
Propagation Delay From Input (A) to Output (B)	Push-Pull Driving	t_{PLH}	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
	Open-Drain Driving			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
	Push-Pull 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
	Open-Drain Driving			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
	Open-Drain Driving			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
	Open-Drain Driving			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
	Push-Pull 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
	Open-Drain Driving			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
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	3		139	ns
				V_{CCB}=5V±0.5V	3		105	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			450	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
			V_{CCA}=3.3V±0.3V	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}=2.5V±0.2V			50	ns
				V_{CCB}=3.3V±0.3V			40	ns
				V_{CCB}=5V±0.5V			35	ns
			V_{CCA}=2.5V±0.2V	V_{CCB}=2.5V±0.2V			50	ns
				V_{CCB}=3.3V±0.3V			40	ns
				V_{CCB}=5V±0.5V			35	ns
			V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			40	ns
				V_{CCB}=5V±0.5V			35	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
	Open-Drain Driving			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
	Push-Pull 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
	Open-Drain Driving			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
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	25		116	ns
				V_{CCB}=5V±0.5V	19		85	ns

■ SWITCHING CHARACTERISTICS (Cont.)

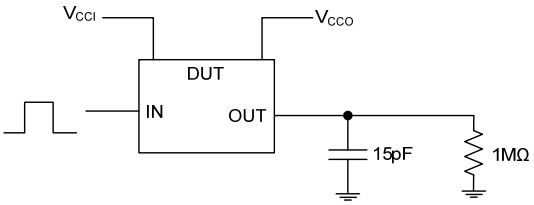
PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Input Rise Time (B Port Rise Time)	Push-Pull Driving	t_{rB}	V_{CCA}=1.8V±0.15V	V_{CCB}=2.5V±0.2V	3.3		13.5	ns
				V_{CCB}=3.3V±0.3V	2.7		11.4	ns
				V_{CCB}=5V±0.5V	2.7		9.5	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	34		145	ns
				V_{CCB}=3.3V±0.3V	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	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		7.4	ns
				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	ns
				V_{CCB}=5V±0.5V	4.2		5.7	ns
Input Fall Time (B Port Fall Time)	Push-Pull Driving	t_{fB}	V_{CCA}=1.8V±0.15V	V_{CCB}=2.5V±0.2V	2.0		9.5	ns
				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	ns
				V_{CCB}=5V±0.5V	4.8		8.3	ns

■ SWITCHING CHARACTERISTICS (Cont.)

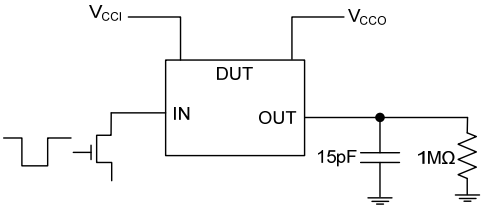
PARAMETER			SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Data Rate	Push-Pull Driving		f_{data}	V_{CCA}=1.65V~2.7V, V_{CCB}=2.3V~5.5V			24	Mbps
				V_{CCA}=3V~3.6V, V_{CCB}=3.6V~5.5V			24	Mbps
	Open-Drain Driving			V_{CCA}=1.65V~2.7V, V_{CCB}=2.3V~5.5V			2	Mbps
				V_{CCA}=3V~3.6V, V_{CCB}=3.6V~5.5V			2	Mbps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

■ TEST CIRCUIT AND WAVEFORMS

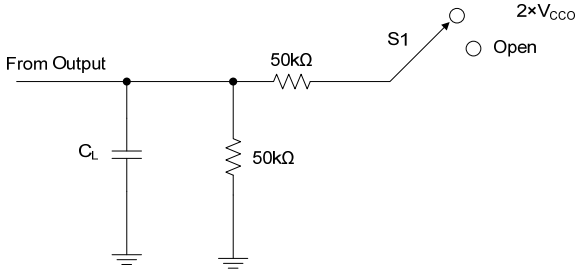
Load Circuits



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

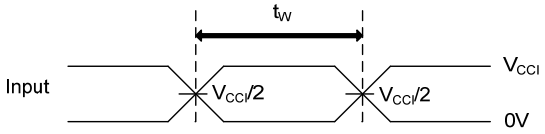


Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using an Open-Drain Driver

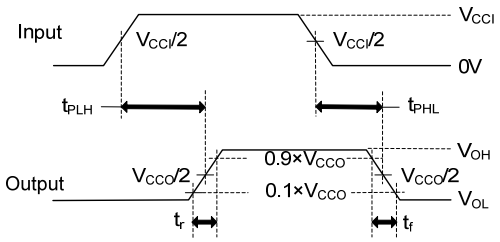


TEST	S1
t_{PLZ}/t_{PZL}	$2\times V_{CCO}$
t_{PHZ}/t_{PZH}	Open

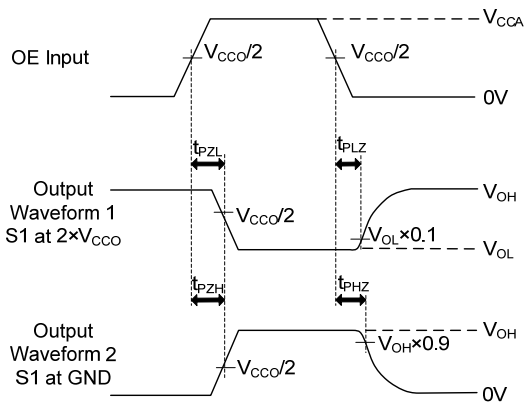
Notes: 1. C_L includes probe and jig capacitance.
2. t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.
3. V_{CCI} is the supply voltage associated with the input.
4. V_{CCO} is the supply voltage associated with the input.



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. 10kΩ 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.

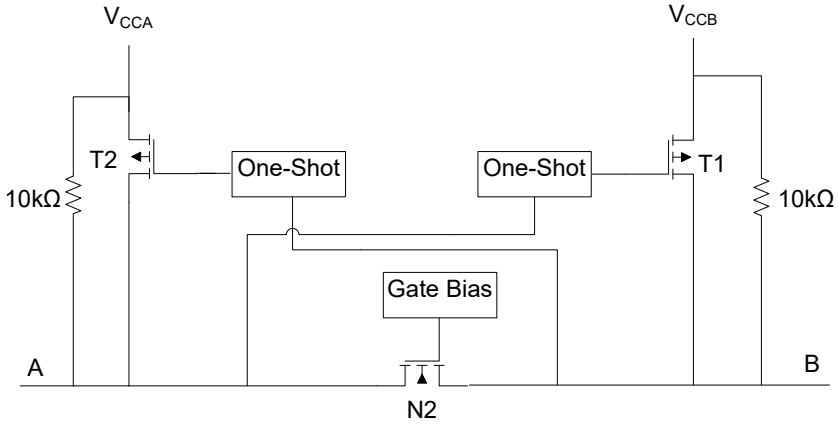


Figure 1. Architecture of UTXB0101 I/O Cell

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