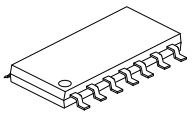
4-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR FOR OPEN-DRAIN AND PUSH-PULL APPLICATIONS



SOP-14

■ DESCRIPTION

The UTC **UVXS0104** is a 4-bit non-inverting bidirectional voltage-level translator. The UTC **UVXS0104** separates A ports with B ports, and both ports are configurable power-supply rails, with the A ports supporting operating voltages from 1.65V to 3.6V, and the B ports supporting operating voltages from 2.3V to 5.5V. This allows the support of both lower and higher logic signal levels while providing bidirectional translation capabilities between any of the 1.8V, 2.5V, 3.3V, and 5V voltage nodes.

All I/Os of the UTC **UVXS0104** are placed in the high-impedance state when the output-enable (OE) input is low, The UTC **UVXS0104** is designed so that the OE input circuit is supplied by V_{CCA}. So, 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

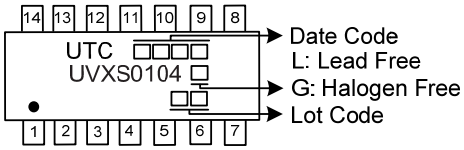
* Maximum Data Rates
  24 Mbps (Push Pull)
  2 Mbps (Open Drain)
* 1.65V~3.6V on A ports and 2.3V~5.5V on B ports ($V_{CCA} \leq V_{CCB}$)
* No Direction-Control Signal Needed
* No Power-Supply Sequencing Required: -V_{CCA} or V_{CCB} Can Be Ramped First

■ ORDERING INFORMATION

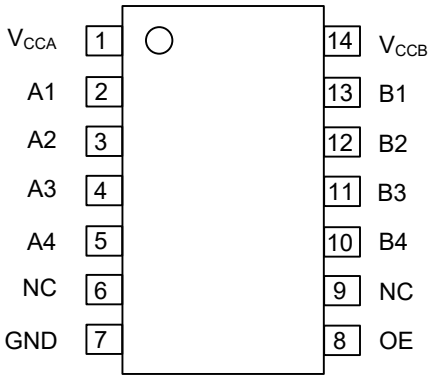
Ordering Number		Package	Packing
Lead Free	Halogen Free		
UVXS0104L-S14-R	UVXS0104G-S14-R	SOP-14	Tape Reel

UVXS0104G-S14-R (1)Packing Type (2)Package Type (3)Green Package	(1) R: Tape Reel (2) S14: SOP-14 (3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING



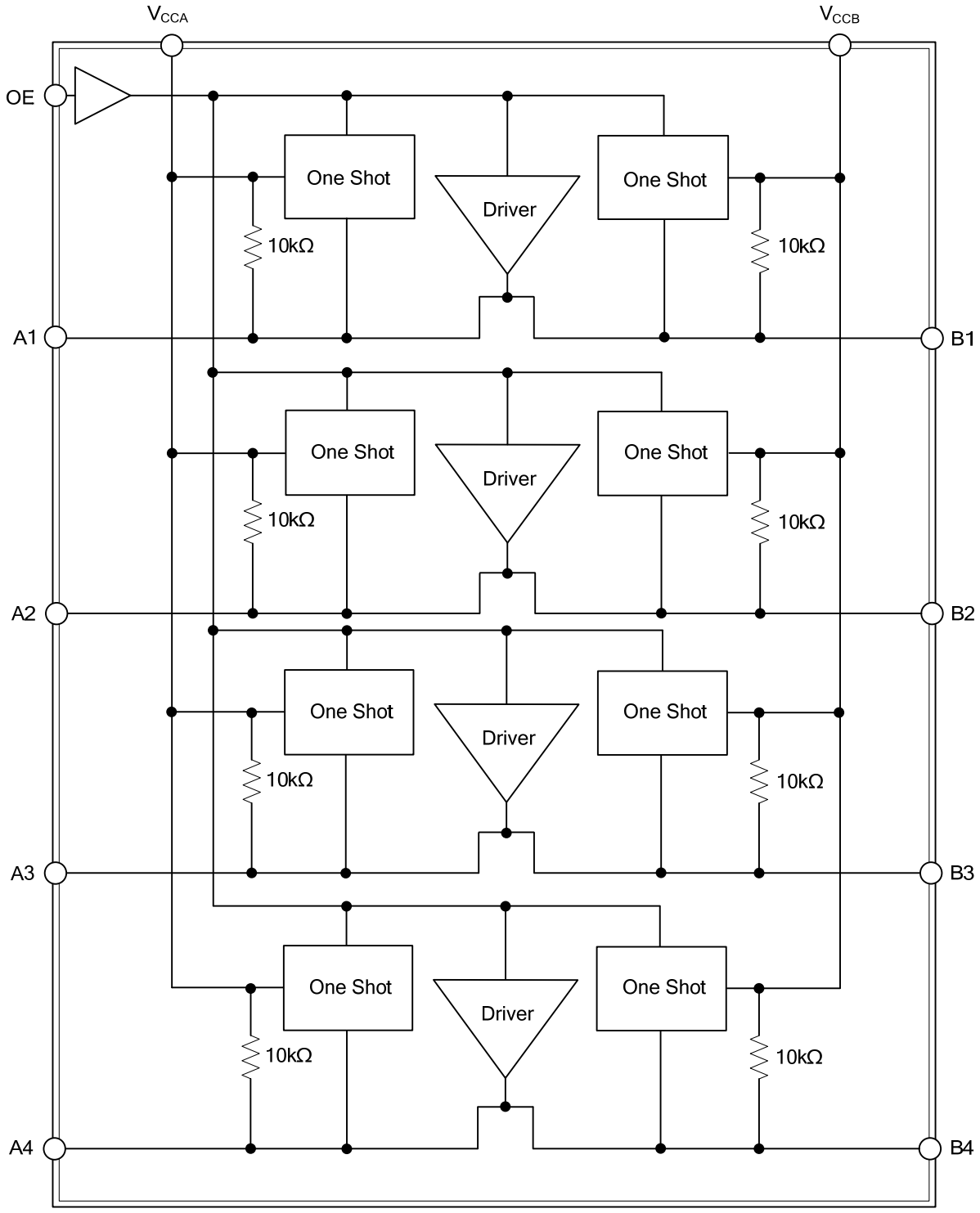
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	V_{CCA}	A-port supply voltage. 1.65V ≤ V_{CCA} ≤ 3.6V and V_{CCA} ≤ V_{CCB}.
2	A1	Input/output A1. Referenced to V_{CCA}.
3	A2	Input/output A2. Referenced to V_{CCA}.
4	A3	Input/output A3. Referenced to V_{CCA}.
5	A4	Input/output A4. Referenced to V_{CCA}.
6	NC	No internal connection
7	GND	Ground
8	OE	3-state output-mode enable. Pull OE low to place all outputs in 3-state mode. Referenced to V_{CCA}.
9	NC	No internal connection
10	B4	Input/output B4. Referenced to V_{CCB}.
11	B3	Input/output B3. Referenced to V_{CCB}.
12	B2	Input/output B2. Referenced to V_{CCB}.
13	B1	Input/output B1. Referenced to V_{CCB}.
14	V_{CCB}	B-port supply voltage. 2.3V ≤ V_{CCB} ≤ 5.5V.

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING (NOTE 1)

PARAMETER		SYMBOL	RATINGS	UNIT
Supply Voltage Range		V_{CCA}	-0.5 ~ 4.6	V
Supply Voltage Range		V_{CCB}	-0.5 ~ 6.5	V
Input Voltage Range (Note 2)	A port	V_I	-0.5 ~ 4.6	V
	B port		-0.5 ~ 6.5	
Voltage Range Applied To Any Output In The High-Impedance Or Power-Off State (Note 2)	A port	V_O	-0.5 ~ 4.6	V
	B port		-0.5 ~ 6.5	
Voltage Range Applied To Any Output In The High Or Low State (Note 2, 3)	A port	V_O	-0.5 ~ V_{CCA}+0.5	V
	B port		-0.5 ~ V_{CCB}+0.5	
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
Junction Temperature		T_J	+150	°C
Storage Temperature		T_{STG}	-65 ~ +150	°C

Notes: 1. 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.
2. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
3. The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

■ RECOMMENDED OPERATING CONDITIONS

V_{CCI} is the supply voltage associated with the input port. V_{CCO} is the supply voltage associated with the output port.

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage (Note 1)		V_{CCA}		1.65		3.6	V
Supply Voltage (Note 1)		V_{CCB}		2.3		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 Push-Pull Driving	Δt/Δv	V_{CCA}=1.65V ~ 3.6V, V_{CCB}=2.3V ~ 5.5V			10	ns/V
	B-Port I/Os Push-Pull Driving					10	ns/V
	Control Input					10	ns/V
Operating Free-Air Temperature		T_A		-40		+125	°C

Note: 1. V_{CCA} must be less than or equal to V_{CCB}, and V_{CCA} must not exceed 3.6V.

■ ELECTRICAL CHARACTERISTICS (Note 1, 2, 3) (T_A=25°C, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Port A Output High Voltage		V_{OHA}	I_{OH}=-20μA, V_{IB}≥V_{CCB}-0.4V, V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V		V_{CCA} ×0.8			V
Port A Output Low Voltage		V_{OLA}	I_{OL}=1mA, V_{IB}≤0.15V, V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V				0.4	V
Port B Output High Voltage		V_{OHB}	I_{OH} =-20μA, V_{IA} ≥ V_{CCA} - 0.2V, V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V		V_{CCB} ×0.8			V
Port B Output Low Voltage		V_{OLB}	I_{OL}=1mA, V_{IA}≤0.15V, V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V				0.4	V
Input Leakage Current	OE	I_I	V_I = V_{CCI} or GND, V_{CCA}=1.65V~3.6V, V_{CCB}=2.3V~5.5V				±2	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 = V_{IL}				±2	μA
V_{CCA} 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
V_{CCB} Supply Current		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
Combined Supply Current		I_{CCA}+I_{CCB}		V_{CCA}=1.65V~V_{CCB} V_{CCB}=2.3V~5.5V			14.4	μA
Input Capacitance	OE	C_I	V_{CCA}=3.3V , V_{CCB}=3.3V			2.5		pF
Input-to-Output Internal Capacitance	A port	C_{IO}				5		pF
	B port					12		pF

Notes: 1. V_{CCI} is the V_{CC} associated with the input port.
2. V_{CCO} is the V_{CC} 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}=1.8V±0.15V	V_{CCB}=2.5V±0.2V			10.6	ns
				V_{CCB}=3.3V±0.3V			10.7	ns
				V_{CCB}=5V±0.5V			11.8	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	1		14.8	ns
				V_{CCB}=3.3V±0.3V	1		15.6	ns
				V_{CCB}=5V±0.5V	1		16	ns
	Push-Pull Driving		V_{CCA}=2.5V±0.2V	V_{CCB}=2.5V±0.2V			8.2	ns
				V_{CCB}=3.3V±0.3V			8.3	ns
				V_{CCB}=5V±0.5V			8.4	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	1		12.3	ns
				V_{CCB}=3.3V±0.3V	1		12.0	ns
				V_{CCB}=5V±0.5V	1		11.8	ns
	Push-Pull Driving		V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			7.4	ns
				V_{CCB}=5V±0.5V			8.1	ns
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	1		9.2	ns
				V_{CCB}=5V±0.5V	1		9.6	ns
Propagation Delay From Input (B) to Output (A)	Push-Pull Driving		V_{CCA}=1.8V±0.15V	V_{CCB}=2.5V±0.2V			10.4	ns
				V_{CCB}=3.3V±0.3V			10.5	ns
				V_{CCB}=5V±0.5V			10.7	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	1		11.3	ns
				V_{CCB}=3.3V±0.3V	1		10.4	ns
				V_{CCB}=5V±0.5V	1		10.0	ns
	Push-Pull Driving		V_{CCA}=2.5V±0.2V	V_{CCB}=2.5V±0.2V			8.0	ns
				V_{CCB}=3.3V±0.3V			8.6	ns
				V_{CCB}=5V±0.5V			9.3	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	1		11.7	ns
				V_{CCB}=3.3V±0.3V	1		11.2	ns
				V_{CCB}=5V±0.5V	1		11.0	ns
	Push-Pull Driving		V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			7.5	ns
				V_{CCB}=2.5V±0.2V			8.3	ns
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	1		138	ns
				V_{CCB}=5V±0.5V	1		108	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			11.8	ns
				V_{CCB}=3.3V±0.3V			11.8	ns
				V_{CCB}=5V±0.5V			12	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	40		273	ns
				V_{CCB}=3.3V±0.3V	30		218	ns
				V_{CCB}=5V±0.5V	20		208	ns
	Push-Pull Driving		V_{CCA}=2.5V±0.2V	V_{CCB}=2.5V±0.2V			9.5	ns
				V_{CCB}=3.3V±0.3V			10.1	ns
				V_{CCB}=5V±0.5V			10.4	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	40		263	ns
				V_{CCB}=3.3V±0.3V	30		213	ns
				V_{CCB}=5V±0.5V	20		203	ns
	Push-Pull Driving		V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			9.2	ns
				V_{CCB}=5V±0.5V			9.4	ns
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	30		213	ns
				V_{CCB}=5V±0.5V	20		178	ns

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

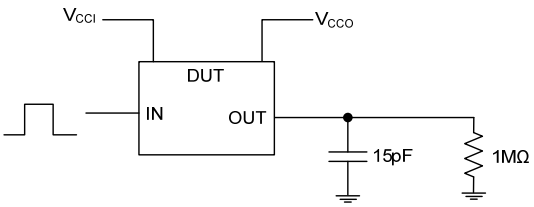
PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Propagation Delay From Input (B) to Output (A)	Push-Pull Driving	t_{PLH}	V_{CCA}=1.8V±0.15V	V_{CCB}=2.5V±0.2V			11.3	ns
				V_{CCB}=3.3V±0.3V			10.5	ns
				V_{CCB}=5V±0.5V			6.5	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	40		188	ns
				V_{CCB}=3.3V±0.3V	30		153	ns
				V_{CCB}=5V±0.5V	20		113	ns
	Push-Pull Driving		V_{CCA}=2.5V±0.2V	V_{CCB}=2.5V±0.2V			8.5	ns
				V_{CCB}=3.3V±0.3V			7.6	ns
				V_{CCB}=5V±0.5V			6.7	ns
	Open-Drain Driving			V_{CCB}=2.5V±0.2V	40		183	ns
				V_{CCB}=3.3V±0.3V	30		153	ns
				V_{CCB}=5V±0.5V	20		113	ns
	Push-Pull Driving		V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			7.5	ns
				V_{CCB}=5V±0.5V			7.6	ns
	Open-Drain Driving			V_{CCB}=3.3V±0.3V	1		148	ns
				V_{CCB}=5V±0.5V	1		118	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			250	ns
				V_{CCB}=3.3V±0.3V			250	ns
				V_{CCB}=5V±0.5V			250	ns
			V_{CCA}=2.5V±0.2V	V_{CCB}=2.5V±0.2V			250	ns
				V_{CCB}=3.3V±0.3V			250	ns
				V_{CCB}=5V±0.5V			250	ns
			V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			250	ns
				V_{CCB}=5V±0.5V			250	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			230	ns
				V_{CCB}=3.3V±0.3V			230	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			180	ns
			V_{CCA}=3.3V±0.3V	V_{CCB}=3.3V±0.3V			180	ns
				V_{CCB}=5V±0.5V			150	ns

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

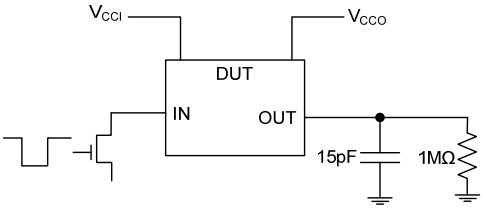
PARAMETER			SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Data Rate	Push-Pull Driving		f_{data}	V_{CCA}==1.65V~2.7V V_{CCB} =2.3V~5.5V			24	Mbps
				V_{CCA}==3V~3.6V V_{CCB} =3.6V~5.5V			24	Mbps
	Open-Drain Driving			V_{CCA}==1.65V~2.7V V_{CCB} =2.3V~5.5V			2	Mbps
				V_{CCA}==3V~3.6V V_{CCB} =3.6V~5.5V		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

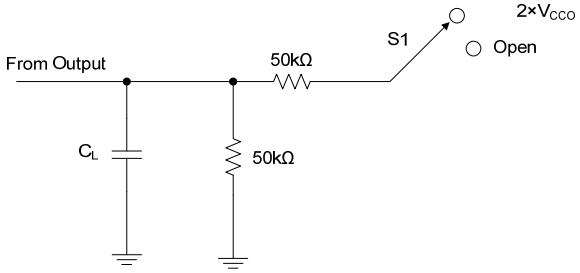
Load Circuits



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

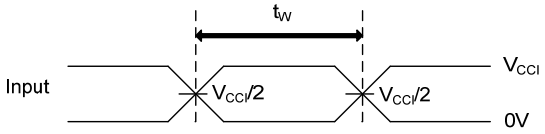


Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using an Open-Drain Driver

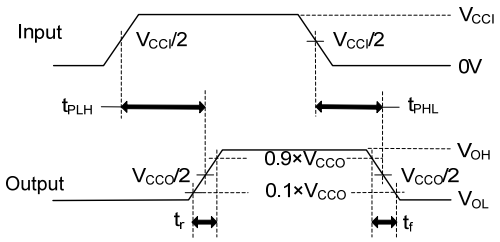


TEST	S1
t_{PLZ}/t_{PZL}	$2\times V_{CCO}$
t_{PHZ}/t_{PZH}	Open

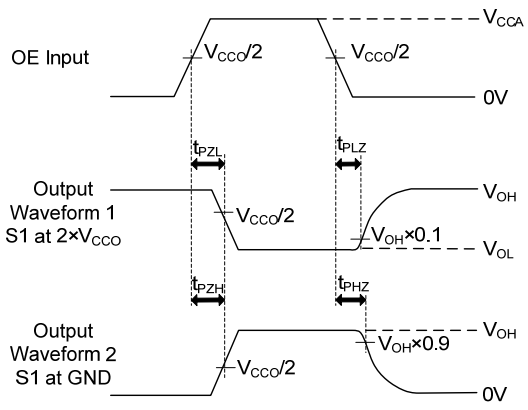
Notes: 1. C_L includes probe and jig capacitance.
2. t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.
3. V_{CCI} is the supply voltage associated with the input.
4. V_{CCO} is the supply voltage associated with the input.



PULSE DURATION



PROPAGATION DELAY TIMES



ENABLE AND DISABLE TIMES

■ TYPICAL APPLICATION CIRCUIT