

SN74AXC4T245 Four-Bit Bus Transceiver with Configurable Voltage Translation and Tri-State Outputs

1 Features

- Fully Configurable Dual-Rail Design Allows Each Port to Operate With a Power Supply Range From 0.65 V to 3.6 V
- Operating Temperature From -40°C to $+125^{\circ}\text{C}$
- Multiple Direction Control Pins to Allow Simultaneous Up and Down Translation
- Glitch-Free Power Supply Sequencing
- Up to 380 Mbps Support When Translating from 1.8 V to 3.3 V
- V_{CC} Isolation Feature
 - If Either V_{CC} Input is Below 100 mV, All I/Os Outputs are Disabled and Become High-Impedance
- I_{off} Supports Partial-Power-Down Mode Operation
- Compatible With AVC Family Level Shifters
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 8000-V Human-Body Model
 - 1000-V Charged-Device Model

2 Applications

- Enterprise and Communications
- Industrial
- Personal Electronics
- Wireless Infrastructure
- Building Automation
- Point of Sale

3 Description

The SN74AXC4T245 is a four-bit noninverting bus transceiver that uses two individually configurable power-supply rails. The device is operational with both V_{CCA} and V_{CCB} supplies as low as 0.65 V. The A port is designed to track V_{CCA} , which accepts any supply voltage from 0.65 V to 3.6 V. The B port is designed to track V_{CCB} , which also accepts any supply voltage from 0.65 V to 3.6 V. Additionally the SN74AXC4T245 is compatible with a single-supply system.

The SN74AXC4T245 device is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level of the direction-control inputs (1DIR and 2DIR). The output-enable inputs (1OE and 2OE) are used to disable the outputs so the buses are effectively isolated. The SN74AXC4T245 device is designed so the control pins (xDIR and xOE) are referenced to V_{CCA} .

To ensure the high-impedance state of the level shifter I/Os during power up or power down, the xOE pins should be tied to V_{CCA} through a pullup resistor.

This device is fully specified for partial-power-down applications using the I_{off} current. The I_{off} protection circuitry ensures that no excessive current is drawn from or to an input, output, or combined I/O that is biased to a specific voltage while the device is powered down.

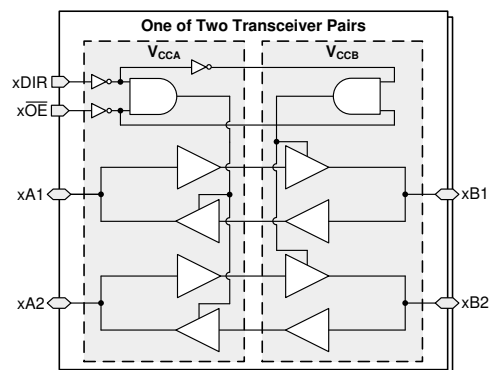
The V_{CC} isolation feature ensures that if either V_{CCA} or V_{CCB} is less than 100 mV, both I/O ports enter a high-impedance state by disabling their outputs.

Glitch-Free power supply sequencing allows either supply rail to be powered on or off in any order while providing robust power sequencing performance.

Device Information

PART NUMBER	PACKAGE ⁽¹⁾	BODY SIZE (NOM)
SN74AXC4T245PW	TSSOP (16)	5.00 mm x 4.40 mm
SN74AXC4T245BQB	WQFN (16)	2.50 mm x 3.50 mm
SN74AXC4T245RSV	UQFN (16)	2.60 mm x 1.80 mm

- (1) For all available packages, see the orderable addendum at the end of the data sheet.



Functional Block Diagram



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4 Revision History

Changes from Revision * (December 2018) to Revision A (July 2020)	Page
• Updated the numbering format for tables, figures and cross-references throughout the document.....	1
• Added BQB (WQFN) package option to <i>Device Information</i> table	1

5 Pin Configuration and Functions

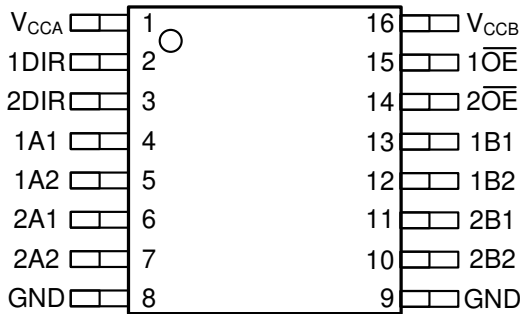


Figure 5-1. PW Package 16-Pin TSSOP Top View

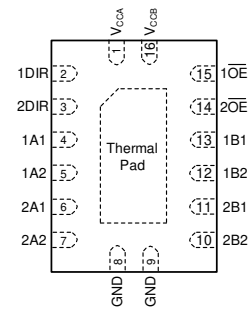


Figure 5-2. BQB Package 16-Pin WQFN Transparent Top View

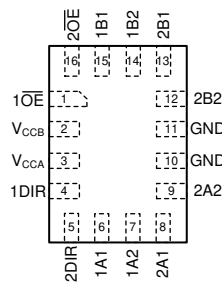


Figure 5-3. RSV Package 16-Pin UQFN Transparent Top View

Pin Functions

PIN NAME	NO.			TYPE	DESCRIPTION
	PW	RSV	BQB		
1A1	4	6	4	I/O	Input/output 1A1. Referenced to V_{CCA} .
1A2	5	7	5	I/O	Input/output 1A2. Referenced to V_{CCA} .
1B1	13	15	13	I/O	Input/output 1B1. Referenced to V_{CCB} .
1B2	12	14	12	I/O	Input/output 1B2. Referenced to V_{CCB} .
1DIR	2	4	2	I	Direction-control input for '1' ports.
1 \overline{OE}	15	1	15	I	Tri-state output-mode enable. Pull \overline{OE} high to place '1' outputs in tri-state mode. Referenced to V_{CCA} .
2A1	6	8	6	I/O	Input/output 2A1. Referenced to V_{CCA} .
2A2	7	9	7	I/O	Input/output 2A2. Referenced to V_{CCA} .
2B1	11	13	11	I/O	Input/output 2B1. Referenced to V_{CCB} .
2B2	10	12	10	I/O	Input/output 2B2. Referenced to V_{CCB} .
2DIR	3	5	3	I	Direction-control input for '2' ports.
2 \overline{OE}	14	16	14	I	Tri-state output-mode enable. Pull \overline{OE} high to place '2' outputs in tri-state mode. Referenced to V_{CCA} .
GND	8, 9	10, 11	8, 9	—	Ground.
V_{CCA}	1	3	1	—	A-port power supply voltage. $0.65\text{ V} \leq V_{CCA} \leq 3.6\text{ V}$.
V_{CCB}	16	2	16	—	B-port power supply voltage. $0.65\text{ V} \leq V_{CCB} \leq 3.6\text{ V}$.

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

			MIN	MAX	UNIT
V _{CCA}	Supply voltage A		-0.5	4.2	V
V _{CCB}	Supply voltage B		-0.5	4.2	V
V _I	Input Voltage ⁽²⁾	I/O Ports (A Port)	-0.5	4.2	V
		I/O Ports (B Port)	-0.5	4.2	
		Control Inputs	-0.5	4.2	
V _O	Voltage applied to any output in the high-impedance or power-off state ⁽²⁾	A Port	-0.5	4.2	V
		B Port	-0.5	4.2	
V _O	Voltage applied to any output in the high or low state ^{(2) (3)}	A Port	-0.5 V _{CCA} + 0.2		V
		B Port	-0.5 V _{CCB} + 0.2		
I _{IK}	Input clamp current	V _I < 0	-50		mA
I _{OK}	Output clamp current	V _O < 0	-50		mA
I _O	Continuous output current		-50	50	mA
	Continuous current through V _{CC} or GND		-100	100	
T _j	Junction Temperature			150	°C
T _{stg}	Storage temperature		-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The output positive-voltage rating may be exceeded up to 4.2 V maximum if the output current rating is observed.

6.2 ESD Ratings

			VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±8000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±1000	

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)^{(1) (2)}

			MIN	MAX	UNIT
V _{CCA}	Supply voltage A		0.65	3.6	V
V _{CCB}	Supply voltage B		0.65	3.6	V
V _{IH}	High-level input voltage	Data Inputs	V _{CCI} = 0.65 V - 0.75 V	V _{CCI} × 0.70	V
			V _{CCI} = 0.76 V - 1 V	V _{CCI} × 0.70	
			V _{CCI} = 1.1 V - 1.95 V	V _{CCI} × 0.65	
			V _{CCI} = 2.3 V - 2.7 V	1.6	
			V _{CCI} = 3 V - 3.6 V	2	
	Control Inputs(xDIR, x \overline{OE}) Referenced to V _{CCA}	V _{CCA} = 0.65 V - 0.75 V	V _{CCA} × 0.70		
		V _{CCA} = 0.76 V - 1 V	V _{CCA} × 0.70		
		V _{CCA} = 1.1 V - 1.95 V	V _{CCA} × 0.65		
		V _{CCA} = 2.3 V - 2.7 V	1.6		
		V _{CCA} = 3 V - 3.6 V	2		
V _{IL}	Low-level input voltage	Data Inputs	V _{CCI} = 0.65 V - 0.75 V	V _{CCI} × 0.30	V
			V _{CCI} = 0.76 V - 1 V	V _{CCI} × 0.30	
			V _{CCI} = 1.1 V - 1.95 V	V _{CCI} × 0.35	
			V _{CCI} = 2.3 V - 2.7 V	0.7	
			V _{CCI} = 3 V - 3.6 V	0.8	
	Control Inputs(xDIR, x \overline{OE}) Referenced to V _{CCA}	V _{CCA} = 0.65 V - 0.75 V	V _{CCA} × 0.30		
		V _{CCA} = 0.76 V - 1 V	V _{CCA} × 0.30		
		V _{CCA} = 1.1 V - 1.95 V	V _{CCA} × 0.35		
		V _{CCA} = 2.3 V - 2.7 V	0.7		
		V _{CCA} = 3 V - 3.6 V	0.8		
V _I	Input voltage ⁽²⁾		0	3.6	V
V _O	Output voltage	Active State	0	V _{CCO}	V
		Tri-State	0	3.6	
$\Delta t/\Delta v$ ⁽²⁾	Input transition rate			10	ns/V
T _A	Operating free-air temperature		-40	125	°C

(1) V_{CCI} is the V_{CC} associated with the input port. V_{CCO} is the V_{CC} associated with the output port.

(2) All unused inputs of the device must be held at VCC or GND to ensure proper device operation. Refer to the TI application report, [Implications of Slow or Floating CMOS Inputs](#).

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		SN74AXC4T245			UNIT
		PW (TSSOP)	RSV (UQFN)	BQB (WQFN)	
		16 PINS	16 PINS	16 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	126.9	130.1	73.0	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	49.3	70.3	35.1	°C/W
R _{θJB}	Junction-to-board thermal resistance	74.3	57.4	42.8	°C/W
ψ _{JT}	Junction-to-top characterization parameter	8.1	4.6	4.6	°C/W
ψ _{JB}	Junction-to-board characterization parameter	73.4	55.8	42.8	°C/W
R _{θJC(bottom)}	Junction-to-case (bottom) thermal resistance	NA	NA	10.2	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics

over operating free-air temperature range (unless otherwise noted) ⁽¹⁾ ⁽²⁾

PARAMETER	TEST CONDITIONS	V_{CCA}	V_{CCB}	Operating free-air temperature (T_A)						UNIT
				–40°C to 85°C			–40°C to 125°C			
				MIN	TYP ⁽⁴⁾	MAX	MIN	TYP ⁽⁴⁾	MAX	
V_{OH}	High-level output voltage	$V_I = V_{IH}$	$I_{OH} = -100 \mu A$	0.7 V - 3.6 V	0.7 V - 3.6 V	$V_{CCO} - 0.1$		$V_{CCO} - 0.1$		V
			$I_{OH} = -50 \mu A$	0.65 V	0.65 V	0.55		0.55		
			$I_{OH} = -200 \mu A$	0.76 V	0.76 V	0.58		0.58		
			$I_{OH} = -500 \mu A$	0.85 V	0.85 V	0.65		0.65		
			$I_{OH} = -3 \text{ mA}$	1.1 V	1.1 V	0.85		0.85		
			$I_{OH} = -6 \text{ mA}$	1.4 V	1.4 V	1.05		1.05		
			$I_{OH} = -8 \text{ mA}$	1.65 V	1.65 V	1.2		1.2		
			$I_{OH} = -12 \text{ mA}$	3 V	3 V	2.3		2.3		
V_{OL}	Low-level output voltage	$V_I = V_{IL}$	$I_{OL} = 100 \mu A$	0.7 V - 3.6 V	0.7 V - 3.6 V	0.1		0.1		V
			$I_{OL} = 50 \mu A$	0.65 V	0.65 V	0.1		0.1		
			$I_{OL} = 200 \mu A$	0.76 V	0.76 V	0.18		0.18		
			$I_{OL} = 500 \mu A$	0.85 V	0.85 V	0.2		0.2		
			$I_{OL} = 3 \text{ mA}$	1.1 V	1.1 V	0.25		0.25		
			$I_{OL} = 6 \text{ mA}$	1.4 V	1.4 V	0.35		0.35		
			$I_{OL} = 8 \text{ mA}$	1.65 V	1.65 V	0.45		0.45		
			$I_{OL} = 12 \text{ mA}$	3 V	3 V	0.7		0.7		
I_I	Input leakage current	Control inputs (xDIR, x \overline{OE}): $V_I = V_{CCA}$ or GND	0.65 V - 3.6 V	0.65 V - 3.6 V	-0.5	0.5	-1	1	μA	
		Data Inputs (xAx, xBx): $V_I = V_{CCI}$ or GND	0.65 V - 3.6 V	0.65 V - 3.6 V	-4	4	-8	8	μA	
I_{off}	Partial power down current	A or B Port	0 V	0 V - 3.6 V	-4	4	-8	8	μA	
		V_I or $V_O = 0 \text{ V} - 3.6 \text{ V}$	0 V - 3.6 V	0 V	-4	4	-8	8		
I_{OZ}	Tri-state output current ⁽³⁾	A or B Port $V_I = V_{CCI}$ or GND, $V_O = V_{CCO}$ or GND, $\overline{OE} = V_{IH}$	3.6 V	3.6 V	-4	4	-8	8	μA	
I_{CCA}	V_{CCA} supply current	$V_I = V_{CCI}$ or GND	$I_O = 0$	0.65 V - 3.6 V	0.65 V - 3.6 V	13		26		μA
				0 V	3.6 V	-2		-12		
				3.6 V	0 V	8		16		
I_{CCB}	V_{CCB} supply current	$V_I = V_{CCI}$ or GND	$I_O = 0$	0.65 V - 3.6 V	0.65 V - 3.6 V	13		26		μA
				0 V	3.6 V	8		16		
				3.6 V	0 V	-2		-12		
$I_{CCA} + I_{CCB}$	Combined supply current	$V_I = V_{CCI}$ or GND	$I_O = 0$	0.65 V - 3.6 V	0.65 V - 3.6 V	20		40		μA
C_i	Control input capacitance	$V_I = 3.3 \text{ V}$ or GND		3.3 V	3.3 V	4.5		4.5		pF
C_{io}	Data I/O capacitance	$\overline{OE} = V_{CCA}$, $V_O = 1.65 \text{ V DC} + 1 \text{ MHz} - 16 \text{ dBm}$ sine wave		3.3 V	3.3 V	6.6		6.6		pF

(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) For I/O ports, the parameter I_{OZ} includes the input leakage current.

(4) All typical data is taken at 25°C.

6.6 Switching Characteristics, $V_{CCA} = 0.7\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})																UNIT	
				0.7 ± 0.05 V		0.8 ± 0.04 V		0.9 ± 0.045 V		1.2 ± 0.1 V		1.5 ± 0.1 V		1.8 ± 0.15 V		2.5 ± 0.2 V		3.3 ± 0.3 V			
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	155	0.5	108	0.5	76	0.5	40	0.5	37	0.5	40	0.5	67	0.5	185	ns
				-40°C to 125°C	0.5	155	0.5	108	0.5	76	0.5	40	0.5	37	0.5	40	0.5	67	0.5	185	
	B	A	-40°C to 85°C	0.5	156	0.5	128	0.5	106	0.5	55	0.5	21	0.5	15	0.5	11	0.5	10		
			-40°C to 125°C	0.5	156	0.5	128	0.5	106	0.5	55	0.5	21	0.5	15	0.5	11	0.5	10		
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	ns
				-40°C to 125°C	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	0.5	156	
		\overline{OE}	B	-40°C to 85°C	0.5	154	0.5	121	0.5	101	0.5	55	0.5	54	0.5	56	0.5	65	0.5	125	
				-40°C to 125°C	0.5	154	0.5	121	0.5	101	0.5	55	0.5	54	0.5	56	0.5	65	0.5	125	
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	ns
				-40°C to 125°C	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	0.5	238	
		\overline{OE}	B	-40°C to 85°C	0.5	286	0.5	194	0.5	146	0.5	94	0.5	76	0.5	70	0.5	69	0.5	146	
				-40°C to 125°C	0.5	286	0.5	194	0.5	146	0.5	94	0.5	76	0.5	70	0.5	69	0.5	146	

6.7 Switching Characteristics, $V_{CCA} = 0.8\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})																UNIT	
				0.7 ± 0.05 V		0.8 ± 0.04 V		0.9 ± 0.045 V		1.2 ± 0.1 V		1.5 ± 0.1 V		1.8 ± 0.15 V		2.5 ± 0.2 V		3.3 ± 0.3 V			
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	128	0.5	88	0.5	63	0.5	29	0.5	24	0.5	23	0.5	24	0.5	34	ns
				-40°C to 125°C	0.5	128	0.5	88	0.5	63	0.5	29	0.5	24	0.5	23	0.5	24	0.5	34	
		B	A	-40°C to 85°C	0.5	108	0.5	88	0.5	70	0.5	38	0.5	21	0.5	15	0.5	11	0.5	10	
				-40°C to 125°C	0.5	108	0.5	88	0.5	70	0.5	38	0.5	21	0.5	15	0.5	11	0.5	10	
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	ns
				-40°C to 125°C	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	0.5	103	
		\overline{OE}	B	-40°C to 85°C	0.5	143	0.5	110	0.5	90	0.5	42	0.5	36	0.5	36	0.5	37	0.5	47	
				-40°C to 125°C	0.5	143	0.5	110	0.5	90	0.5	42	0.5	36	0.5	36	0.5	37	0.5	47	
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	ns
				-40°C to 125°C	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	0.5	143	
		\overline{OE}	B	-40°C to 85°C	0.5	243	0.5	172	0.5	129	0.5	79	0.5	60	0.5	54	0.5	48	0.5	53	
				-40°C to 125°C	0.5	243	0.5	172	0.5	129	0.5	79	0.5	60	0.5	54	0.5	48	0.5	53	

6.8 Switching Characteristics, $V_{CCA} = 0.9\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})																UNIT	
				0.7 ± 0.05 V		0.8 ± 0.04 V		0.9 ± 0.045 V		1.2 ± 0.1 V		1.5 ± 0.1 V		1.8 ± 0.15 V		2.5 ± 0.2 V		3.3 ± 0.3 V			
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	106	0.5	70	0.5	53	0.5	24	0.5	18	0.5	17	0.5	16	0.5	19	ns
				-40°C to 125°C	0.5	106	0.5	70	0.5	53	0.5	24	0.5	18	0.5	17	0.5	16	0.5	19	
		B	A	-40°C to 85°C	0.5	76	0.5	63	0.5	53	0.5	27	0.5	18	0.5	13	0.5	10	0.5	9	
				-40°C to 125°C	0.5	76	0.5	63	0.5	53	0.5	27	0.5	18	0.5	13	0.5	10	0.5	9	
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	ns
				-40°C to 125°C	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	0.5	81	
		\overline{OE}	B	-40°C to 85°C	0.5	138	0.5	105	0.5	84	0.5	37	0.5	30	0.5	28	0.5	26	0.5	30	
				-40°C to 125°C	0.5	138	0.5	105	0.5	84	0.5	37	0.5	30	0.5	28	0.5	26	0.5	30	
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	ns
				-40°C to 125°C	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	0.5	95	
		\overline{OE}	B	-40°C to 85°C	0.5	222	0.5	148	0.5	116	0.5	71	0.5	52	0.5	46	0.5	39	0.5	39	
				-40°C to 125°C	0.5	222	0.5	148	0.5	116	0.5	71	0.5	52	0.5	46	0.5	39	0.5	39	

6.9 Switching Characteristics, $V_{CCA} = 1.2\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})														UNIT			
				$0.7 \pm 0.05\text{ V}$		$0.8 \pm 0.04\text{ V}$		$0.9 \pm 0.045\text{ V}$		$1.2 \pm 0.1\text{ V}$		$1.5 \pm 0.1\text{ V}$		$1.8 \pm 0.15\text{ V}$		$2.5 \pm 0.2\text{ V}$			$3.3 \pm 0.3\text{ V}$		
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		MIN	MAX	
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	55	0.5	37	0.5	27	0.5	15	0.5	11	0.5	10	0.5	8	0.5	9	ns
				-40°C to 125°C	0.5	55	0.5	37	0.5	27	0.5	15	0.5	11	0.5	10	0.5	8	0.5	9	
	B	A	-40°C to 85°C	0.5	41	0.5	29	0.5	24	0.5	15	0.5	10	0.5	9	0.5	7	0.5	6		
			-40°C to 125°C	0.5	41	0.5	29	0.5	24	0.5	15	0.5	10	0.5	9	0.5	7	0.5	6		
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	ns
				-40°C to 125°C	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	
		\overline{OE}	B	-40°C to 85°C	0.5	132	0.5	99	0.5	79	0.5	31	0.5	24	0.5	21	0.5	18	0.5	18	
				-40°C to 125°C	0.5	132	0.5	99	0.5	79	0.5	31	0.5	24	0.5	21	0.5	18	0.5	18	
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	ns
				-40°C to 125°C	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	0.5	45	
		\overline{OE}	B	-40°C to 85°C	0.5	164	0.5	108	0.5	79	0.5	58	0.5	41	0.5	35	0.5	27	0.5	24	
				-40°C to 125°C	0.5	164	0.5	108	0.5	79	0.5	58	0.5	41	0.5	35	0.5	27	0.5	24	

6.10 Switching Characteristics, $V_{CCA} = 1.5\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})														UNIT			
				0.7 ± 0.05 V		0.8 ± 0.04 V		0.9 ± 0.045 V		1.2 ± 0.1 V		1.5 ± 0.1 V		1.8 ± 0.15 V		2.5 ± 0.2 V			3.3 ± 0.3 V		
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		MIN	MAX	
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	21	0.5	21	0.5	18	0.5	11	0.5	9	0.5	8	0.5	7	0.5	6	ns
				-40°C to 125°C	0.5	21	0.5	21	0.5	18	0.5	11	0.5	9	0.5	8	0.5	7	0.5	6	
	B	A	-40°C to 85°C	0.5	37	0.5	24	0.5	18	0.5	11	0.5	9	0.5	8	0.5	5	0.5	5		
			-40°C to 125°C	0.5	37	0.5	24	0.5	18	0.5	11	0.5	9	0.5	8	0.5	5	0.5	5		
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	ns
				-40°C to 125°C	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	0.5	21	
		\overline{OE}	B	-40°C to 85°C	0.5	131	0.5	97	0.5	77	0.5	29	0.5	21	0.5	19	0.5	15	0.5	15	
				-40°C to 125°C	0.5	131	0.5	97	0.5	77	0.5	29	0.5	21	0.5	19	0.5	15	0.5	15	
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	ns
				-40°C to 125°C	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	0.5	26	
		\overline{OE}	B	-40°C to 85°C	0.5	109	0.5	84	0.5	68	0.5	47	0.5	35	0.5	29	0.5	22	0.5	20	
				-40°C to 125°C	0.5	109	0.5	84	0.5	68	0.5	47	0.5	35	0.5	29	0.5	22	0.5	20	

6.11 Switching Characteristics, $V_{CCA} = 1.8\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})																UNIT		
				0.7 ± 0.05 V		0.8 ± 0.04 V		0.9 ± 0.045 V		1.2 ± 0.1 V		1.5 ± 0.1 V		1.8 ± 0.15 V		2.5 ± 0.2 V		3.3 ± 0.3 V				
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX			
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	15	0.5	15	0.5	13	0.5	9	0.5	8	0.5	7	0.5	6	0.5	6	ns	
				-40°C to 125°C	0.5	15	0.5	15	0.5	13	0.5	9	0.5	8	0.5	7	0.5	6	0.5	6		
		B	A	-40°C to 85°C	0.5	40	0.5	23	0.5	17	0.5	10	0.5	8	0.5	7	0.5	5	0.5	4		ns
				-40°C to 125°C	0.5	40	0.5	23	0.5	17	0.5	10	0.5	8	0.5	7	0.5	5	0.5	4		
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	ns	
				-40°C to 125°C	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18		
		\overline{OE}	B	-40°C to 85°C	0.5	130	0.5	96	0.5	76	0.5	28	0.5	21	0.5	18	0.5	15	0.5	14	ns	
				-40°C to 125°C	0.5	130	0.5	96	0.5	76	0.5	28	0.5	21	0.5	18	0.5	15	0.5	14		
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	ns	
				-40°C to 125°C	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20		
		\overline{OE}	B	-40°C to 85°C	0.5	102	0.5	75	0.5	62	0.5	41	0.5	32	0.5	27	0.5	20	0.5	18	ns	
				-40°C to 125°C	0.5	102	0.5	75	0.5	62	0.5	41	0.5	32	0.5	27	0.5	20	0.5	18		

6.12 Switching Characteristics, $V_{CCA} = 2.5\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})																UNIT		
				0.7 ± 0.05 V		0.8 ± 0.04 V		0.9 ± 0.045 V		1.2 ± 0.1 V		1.5 ± 0.1 V		1.8 ± 0.15 V		2.5 ± 0.2 V		3.3 ± 0.3 V				
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX			
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	11	0.5	11	0.5	10	0.5	7	0.5	5	0.5	5	0.5	5	0.5	5	ns	
				-40°C to 125°C	0.5	11	0.5	11	0.5	11	0.5	7	0.5	5	0.5	5	0.5	5	0.5	5		
		B	A	-40°C to 85°C	0.5	67	0.5	24	0.5	16	0.5	8	0.5	7	0.5	6	0.5	5	0.5	4		ns
				-40°C to 125°C	0.5	67	0.5	24	0.5	16	0.5	8	0.5	7	0.5	6	0.5	5	0.5	4		
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	ns	
				-40°C to 125°C	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13		
		\overline{OE}	B	-40°C to 85°C	0.5	128	0.5	95	0.5	76	0.5	27	0.5	20	0.5	17	0.5	13	0.5	13		ns
				-40°C to 125°C	0.5	128	0.5	95	0.5	76	0.5	27	0.5	20	0.5	17	0.5	13	0.5	13		
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	ns	
				-40°C to 125°C	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13	0.5	13		
		\overline{OE}	B	-40°C to 85°C	0.5	120	0.5	70	0.5	56	0.5	36	0.5	26	0.5	22	0.5	18	0.5	16		ns
				-40°C to 125°C	0.5	120	0.5	70	0.5	56	0.5	36	0.5	26	0.5	22	0.5	18	0.5	16		

6.13 Switching Characteristics, $V_{CCA} = 3.3\text{ V}$

See [Figure 1](#) and [Table 1](#) for test circuit and loading. See [Figure 2](#), [Figure 3](#), and [Figure 4](#) for measurement waveforms.

PARAMETER	FROM	TO	Test Conditions	B-Port Supply Voltage (V_{CCB})																UNIT		
				$0.7 \pm 0.05\text{ V}$		$0.8 \pm 0.04\text{ V}$		$0.9 \pm 0.045\text{ V}$		$1.2 \pm 0.1\text{ V}$		$1.5 \pm 0.1\text{ V}$		$1.8 \pm 0.15\text{ V}$		$2.5 \pm 0.2\text{ V}$		$3.3 \pm 0.3\text{ V}$				
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX			
t_{pd}	Propagation delay	A	B	-40°C to 85°C	0.5	10	0.5	10	0.5	9	0.5	6	0.5	5	0.5	4	0.5	4	0.5	4	ns	
				-40°C to 125°C	0.5	10	0.5	10	0.5	9	0.5	6	0.5	5	0.5	4	0.5	4	0.5	4		
		B	A	-40°C to 85°C	0.5	185	0.5	34	0.5	19	0.5	9	0.5	6	0.5	6	0.5	5	0.5	4		ns
				-40°C to 125°C	0.5	185	0.5	34	0.5	19	0.5	9	0.5	6	0.5	6	0.5	5	0.5	4		
t_{dis}	Disable time	\overline{OE}	A	-40°C to 85°C	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12	ns	
				-40°C to 125°C	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12	0.5	12		
		\overline{OE}	B	-40°C to 85°C	0.5	141	0.5	95	0.5	75	0.5	27	0.5	19	0.5	17	0.5	13	0.5	12		ns
				-40°C to 125°C	0.5	141	0.5	95	0.5	75	0.5	27	0.5	19	0.5	17	0.5	13	0.5	12		
t_{en}	Enable time	\overline{OE}	A	-40°C to 85°C	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11	ns	
				-40°C to 125°C	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11	0.5	11		
		\overline{OE}	B	-40°C to 85°C	0.5	189	0.5	82	0.5	59	0.5	35	0.5	24	0.5	20	0.5	16	0.5	14		ns
				-40°C to 125°C	0.5	189	0.5	82	0.5	59	0.5	35	0.5	24	0.5	20	0.5	16	0.5	14		

6.14 Operating Characteristics: T_A = 25°C

PARAMETER		TEST CONDITIONS	V _{CCA}	V _{CCB}	MIN	TYP	MAX	UNIT
C _{pdA}	Power Dissipation Capacitance per transceiver (A to B: outputs enabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		2.2		pF
			0.8 V	0.8 V		2.1		
			0.9 V	0.9 V		2.1		
			1.2 V	1.2 V		2.1		
			1.5 V	1.5 V		2.0		
			1.8 V	1.8 V		2.0		
			2.5 V	2.5 V		2.1		
			3.3 V	3.3 V		2.3		
	Power Dissipation Capacitance per transceiver (A to B: outputs disabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		1.5		pF
			0.8 V	0.8 V		1.5		
			0.9 V	0.9 V		1.5		
			1.2 V	1.2 V		1.4		
			1.5 V	1.5 V		1.4		
			1.8 V	1.8 V		1.4		
			2.5 V	2.5 V		1.4		
			3.3 V	3.3 V		1.6		
	Power Dissipation Capacitance per transceiver (B to A: outputs enabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		12.1		pF
			0.8 V	0.8 V		12.1		
			0.9 V	0.9 V		12.1		
			1.2 V	1.2 V		12.4		
			1.5 V	1.5 V		13.0		
			1.8 V	1.8 V		14.2		
			2.5 V	2.5 V		17.4		
			3.3 V	3.3 V		20.1		
	Power Dissipation Capacitance per transceiver (B to A: outputs disabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		1.1		pF
			0.8 V	0.8 V		1.1		
			0.9 V	0.9 V		1.1		
			1.2 V	1.2 V		1.1		
1.5 V			1.5 V		1.1			
1.8 V			1.8 V		1.1			
2.5 V			2.5 V		1.1			
3.3 V			3.3 V		1.1			

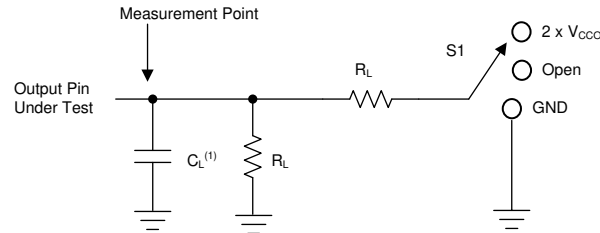
PARAMETER		TEST CONDITIONS	V _{CCA}	V _{CCB}	MIN	TYP	MAX	UNIT
C _{pdB}	Power Dissipation Capacitance per transceiver (A to B: outputs enabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		12.1		pF
			0.8 V	0.8 V		12.1		
			0.9 V	0.9 V		12.1		
			1.2 V	1.2 V		12.4		
			1.5 V	1.5 V		12.9		
			1.8 V	1.8 V		14.1		
			2.5 V	2.5 V		17.2		
			3.3 V	3.3 V		20.1		
	Power Dissipation Capacitance per transceiver (A to B: outputs disabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		1.1		pF
			0.8 V	0.8 V		1.1		
			0.9 V	0.9 V		1.1		
			1.2 V	1.2 V		1.1		
			1.5 V	1.5 V		1.1		
			1.8 V	1.8 V		1.1		
			2.5 V	2.5 V		1.1		
			3.3 V	3.3 V		1.1		
	Power Dissipation Capacitance per transceiver (B to A: outputs enabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		1.2		pF
			0.8 V	0.8 V		1.8		
			0.9 V	0.9 V		1.8		
			1.2 V	1.2 V		1.7		
			1.5 V	1.5 V		1.7		
			1.8 V	1.8 V		1.7		
			2.5 V	2.5 V		2		
			3.3 V	3.3 V		2.5		
	Power Dissipation Capacitance per transceiver (B to A: outputs disabled)	CL = 0, RL = Open f = 1 MHz, tr = tf = 1 ns	0.7 V	0.7 V		1.1		pF
			0.8 V	0.8 V		1.8		
			0.9 V	0.9 V		1.8		
			1.2 V	1.2 V		1.7		
1.5 V			1.5 V		1.7			
1.8 V			1.8 V		1.7			
2.5 V			2.5 V		2			
3.3 V			3.3 V		2.1			

7 Parameter Measurement Information

7.1 Load Circuit and Voltage Waveforms

Unless otherwise noted, all input pulses are supplied by generators having the following characteristics:

- $f = 1 \text{ MHz}$
- $Z_O = 50 \Omega$
- $dv/dt \leq 1 \text{ ns/V}$

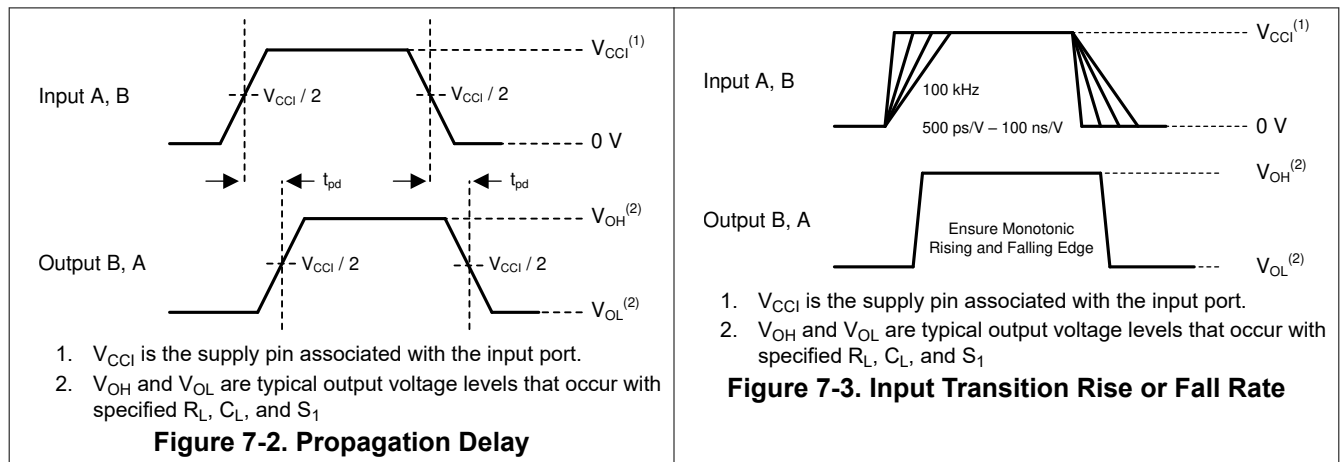


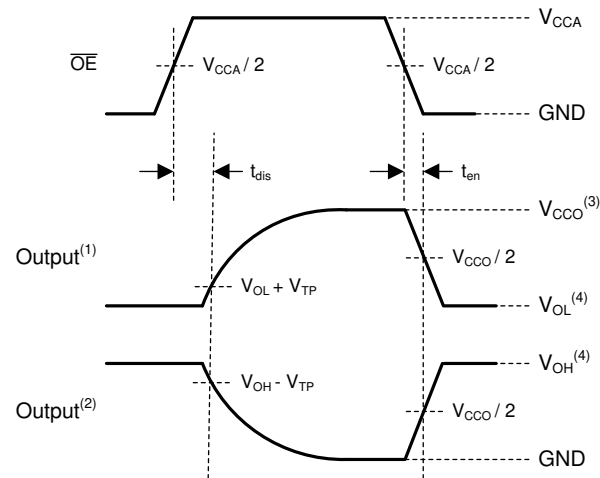
A. C_L includes probe and jig capacitance.

Figure 7-1. Load Circuit

Table 7-1. Load Circuit Conditions

Parameter	V_{CCO}	R_L	C_L	S_1	V_{TP}
$\Delta t/\Delta v$ Input transition rise or fall rate	0.65 V – 3.6 V	1 M Ω	15 pF	Open	N/A
t_{pd} Propagation (delay) time	1.1 V – 3.6 V	2 k Ω	15 pF	Open	N/A
	0.65 V – 0.95 V	20 k Ω	15 pF	Open	N/A
t_{en}, t_{dis} Enable time, disable time	3 V – 3.6 V	2 k Ω	15 pF	$2 \times V_{CCO}$	0.3 V
	1.65 V – 2.7 V	2 k Ω	15 pF	$2 \times V_{CCO}$	0.15 V
	1.1 V – 1.6 V	2 k Ω	15 pF	$2 \times V_{CCO}$	0.1 V
	0.65 V – 0.95 V	20 k Ω	15 pF	$2 \times V_{CCO}$	0.1 V
t_{en}, t_{dis} Enable time, disable time	3 V – 3.6 V	2 k Ω	15 pF	GND	0.3 V
	1.65 V – 2.7 V	2 k Ω	15 pF	GND	0.15 V
	1.1 V – 1.6 V	2 k Ω	15 pF	GND	0.1 V
	0.65 V – 0.95 V	20 k Ω	15 pF	GND	0.1 V





- A. Output waveform on the condition that input is driven to a valid Logic Low.
- B. Output waveform on the condition that input is driven to a valid Logic High.
- C. V_{CCO} is the supply pin associated with the output port.
- D. V_{OH} and V_{OL} are typical output voltage levels with specified R_L , C_L , and S_1 .

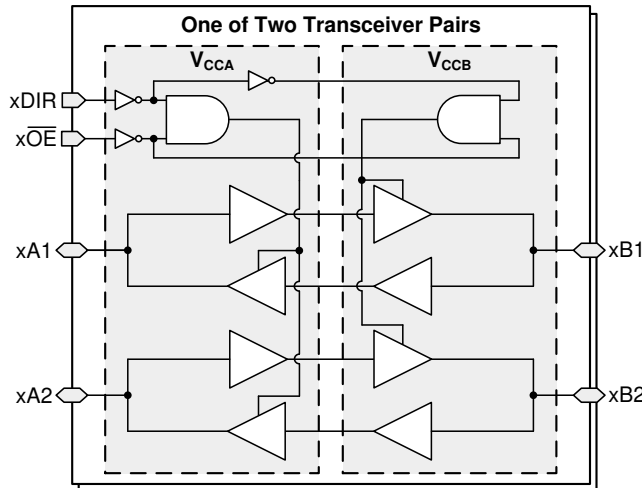
Figure 7-4. Enable Time And Disable Time

8 Detailed Description

8.1 Overview

The SN74AXC4T245 is a 4-bit, dual-supply noninverting bidirectional voltage level translation device. Ax pins and control pins (1DIR, 2DIR, 1 \overline{OE} , and 2 \overline{OE}) are referenced to V_{CCA} logic levels, and Bx pins are referenced to V_{CCB} logic levels. The A port is able to accept I/O voltages ranging from 0.65 V to 3.6 V, while the B port can accept I/O voltages from 0.65 V to 3.6 V. A high on DIR allows data transmission from A to B and a low on DIR allows data transmission from B to A when \overline{OE} is set to low. When \overline{OE} is set to high, both Ax and Bx pins are in the high-impedance state. See [Device Functional Modes](#) for a summary of the operation of the control logic.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Standard CMOS Inputs

Standard CMOS inputs are high impedance and are typically modeled as a resistor in parallel with the input capacitance given in the [Electrical Characteristics](#). The worst case resistance is calculated with the maximum input voltage, given in the [Absolute Maximum Ratings](#), and the maximum input leakage current, given in the [Electrical Characteristics](#), using ohm's law ($R = V \div I$).

Signals applied to the inputs need to have fast edge rates, as defined by $\Delta t/\Delta v$ in [Recommended Operating Conditions](#) to avoid excessive current consumption and oscillations. If a slow or noisy input signal is required, a device with a Schmitt-trigger input should be used to condition the input signal prior to the standard CMOS input.

8.3.2 Balanced High-Drive CMOS Push-Pull Outputs

A balanced output allows the device to sink and source similar currents. The high drive capability of this device creates fast edges into light loads so routing and load conditions should be considered to prevent ringing. Additionally, the outputs of this device are capable of driving larger currents than the device can sustain without being damaged. The electrical and thermal limits defined in the [Absolute Maximum Ratings](#) must be followed at all times.

8.3.3 Partial Power Down (I_{off})

The inputs and outputs for this device enter a high-impedance state when the device is powered down, inhibiting current backflow into the device. The maximum leakage into or out of any input or output pin on the device is specified by I_{off} in the [Electrical Characteristics](#).

8.3.4 V_{CC} Isolation

The inputs and outputs for this device enter a high-impedance state when either supply is $<100mV$.

8.3.5 Over-voltage Tolerant Inputs

Input signals to this device can be driven above the supply voltage so long as they remain below the maximum input voltage value specified in the [Recommended Operating Conditions](#).

8.3.6 Glitch-free Power Supply Sequencing

Either supply rail may be powered on or off in any order without producing a glitch on the I/Os (that is, where the output erroneously transitions to VCC when it should be held low). Glitches of this nature can be misinterpreted by a peripheral as a valid data bit, which could trigger a false device reset of the peripheral, a false device configuration of the peripheral, or even a false data initialization by the peripheral. For more information regarding the power up glitch performance of the AXC family of level translators, see the [Glitch Free Power Sequencing With AXC Level Translators](#) application report

8.3.7 Negative Clamping Diodes

The inputs and outputs to this device have negative clamping diodes as depicted in [Figure 8-1](#).

CAUTION

Voltages beyond the values specified in the [Absolute Maximum Ratings](#) table can cause damage to the device. The input negative-voltage and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

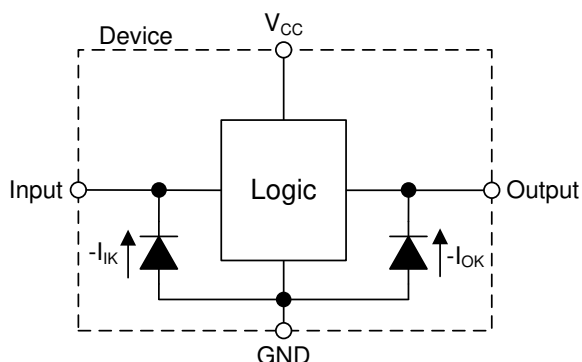


Figure 8-1. Electrical Placement of Clamping Diodes for Each Input and Output

8.3.8 Fully Configurable Dual-Rail Design

Both the V_{CCA} and V_{CCB} pins can be supplied at any voltage from 0.65 V to 3.6 V, making the device suitable for translating between any of the voltage nodes (0.7 V, 0.8 V, 0.9 V, 1.2 V, 1.8 V, 2.5 V and 3.3 V).

8.3.9 Supports High-Speed Translation

The SN74AXC4T245 device can support high data-rate applications. The translated signal data rate can be up to 380 Mbps when the signal is translated from 1.8 V to 3.3 V.

8.4 Device Functional Modes

**Table 8-1. Function Table
(Each 2-Bit Section)**

CONTROL INPUTS ⁽¹⁾		PORT STATUS		OPERATION
OE	DIR	A PORT	B PORT	
L	L	Output (Enabled)	Input (Hi-Z)	B data to A bus
L	H	Input (Hi-Z)	Output (Enabled)	A data to B bus
H	X	Input (Hi-Z)	Input (Hi-Z)	Isolation

(1) Input circuits of the data I/Os are always active.

9 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The SN74AXC4T245 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The SN74AXC4T245 device is ideal for use in applications where a push-pull driver is connected to the data I/Os. The max data rate can be up to 380 Mbps when device translates a signal from 1.8 V to 3.3 V.

One example application is shown in [Figure 9-1](#), where the SN74AXC4T245 device is used to translate a low voltage UART signal from an SoC to a higher voltage signal which properly drive the inputs of the bluetooth module, and vice versa.

9.2 Typical Application

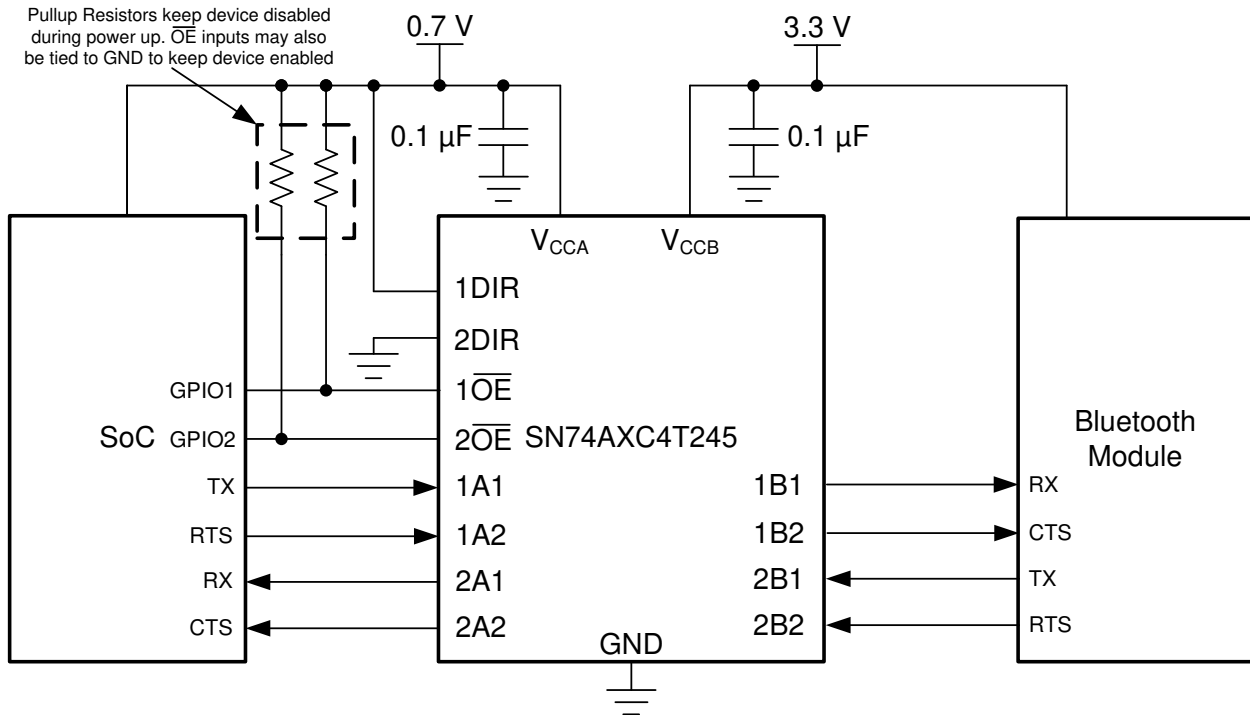


Figure 9-1. UART Interface Application

9.2.1 Design Requirements

For this design example, use the parameters listed in [Table 9-1](#).

Table 9-1. Design Parameters

DESIGN PARAMETERS	EXAMPLE VALUES
Input voltage range	0.65 V to 3.6 V
Output voltage range	0.65 V to 3.6 V

9.2.2 Detailed Design Procedure

To begin the design process, determine the following:

- Input voltage range
 - Use the supply voltage of the device that is driving the SN74AXC4T245 device to determine the input voltage range. For a valid logic-high, the value must exceed the high-level input voltage (V_{IH}) of the input port. For a valid logic low the value must be less than the low-level input voltage (V_{IL}) of the input port.
- Output voltage range
 - Use the supply voltage of the device that the SN74AXC4T245 device is driving to determine the output voltage range.

9.2.3 Application Curve

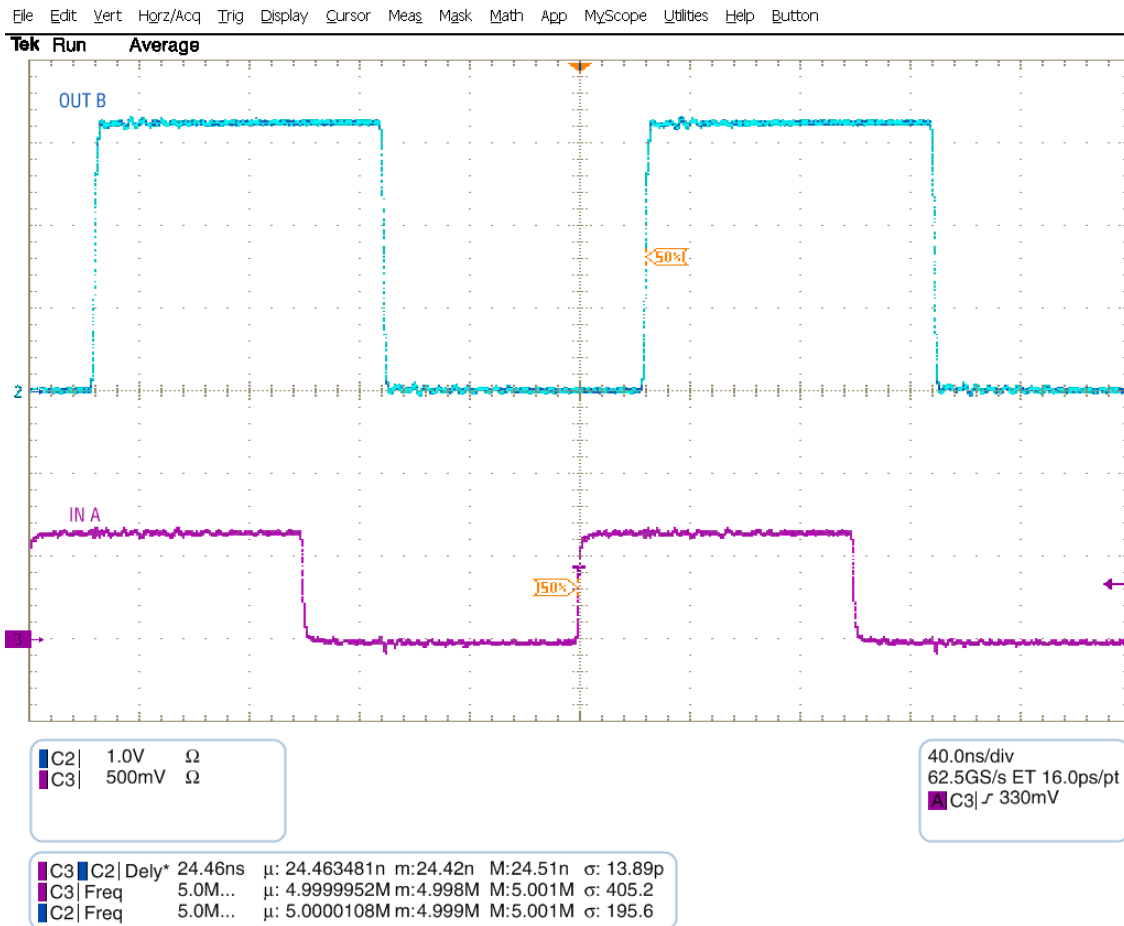


Figure 9-2. Up Translation at 2.5 MHz (0.7 V to 3.3 V)

10 Power Supply Recommendations

Always apply a ground reference to the GND pins first. This device is designed for glitch free power sequencing without any supply sequencing requirements such as ramp order or ramp rate.

This device was designed with various power supply sequencing methods in mind to help prevent unintended triggering of downstream devices. For more information regarding the power up glitch performance of the AXC family of level translators, see the [Glitch Free Power Sequencing With AXC Level Translators](#) application report

11 Layout

11.1 Layout Guidelines

To ensure reliability of the device, following common printed-circuit board layout guidelines are recommended:

- Use bypass capacitors on the power supply pins and place them as close to the device as possible.
- Use short trace lengths to avoid excessive loading.

11.2 Layout Example

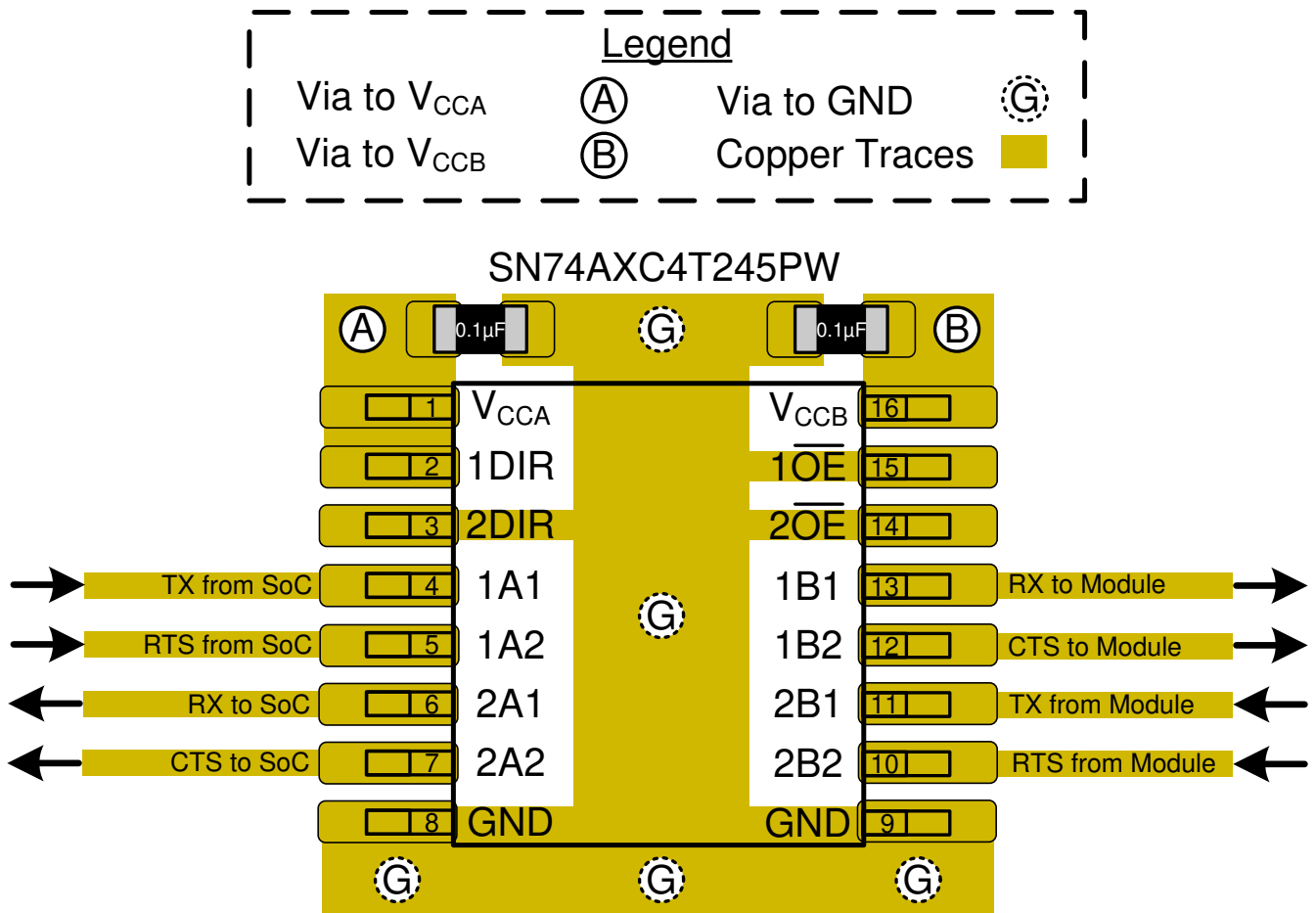


Figure 11-1. Layout Example

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

For related documentation see the following:

Texas Instruments, [Implications of Slow or Floating CMOS Inputs](#) application report

Texas Instruments, [Power Sequencing for AXC Family of Devices](#) application report

12.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on [Subscribe to updates](#) to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

12.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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12.4 Trademarks

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12.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

12.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74AXC4T245BQBR	ACTIVE	WQFN	BQB	16	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	4T245	Samples
SN74AXC4T245PWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU SN	Level-1-260C-UNLIM	-40 to 125	SN4T245	Samples
SN74AXC4T245RSVR	ACTIVE	UQFN	RSV	16	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	1TIR	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF SN74AXC4T245 :

- Automotive: [SN74AXC4T245-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

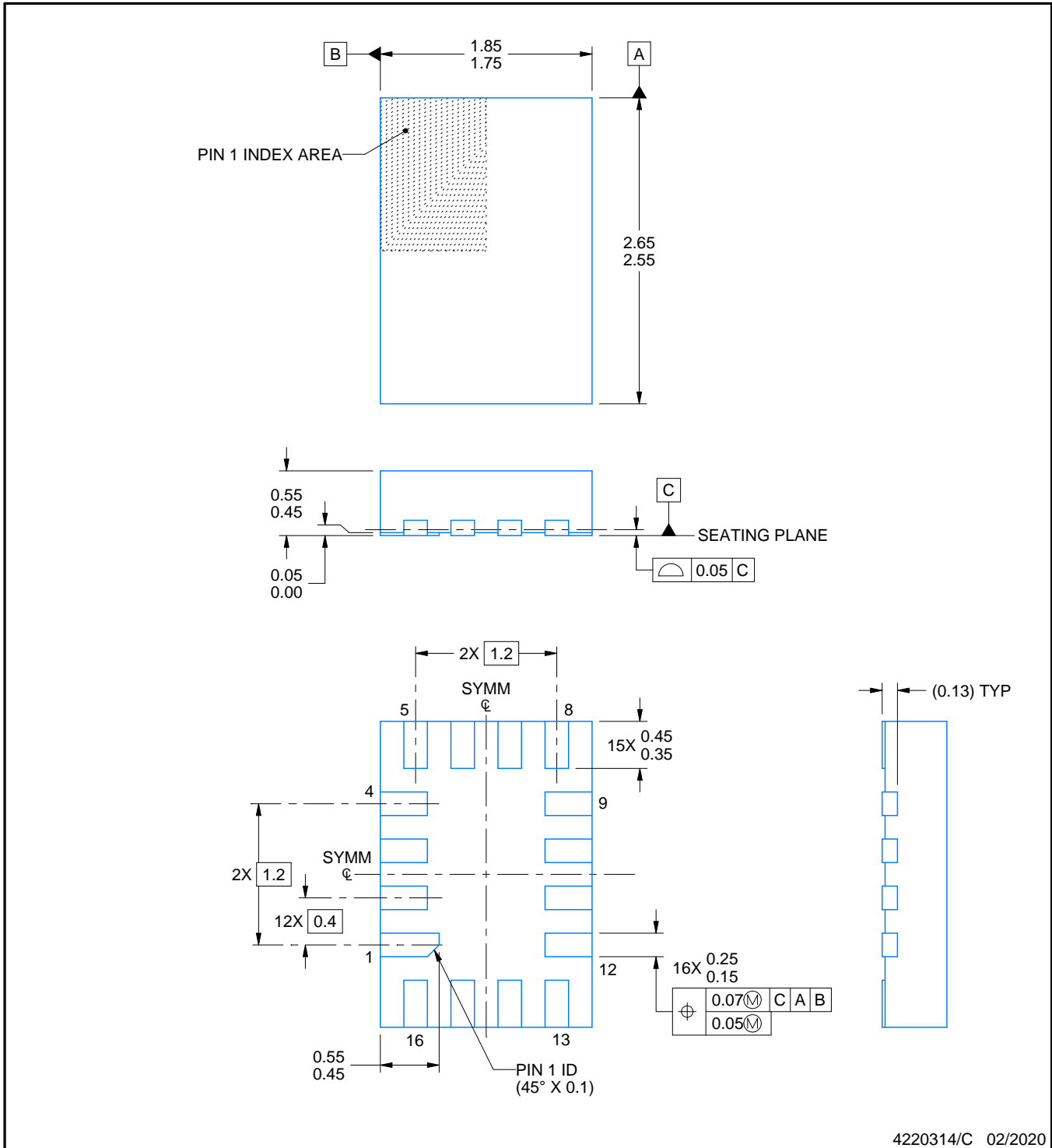
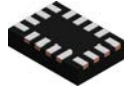

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74AXC4T245BQBR	WQFN	BQB	16	3000	180.0	12.4	2.8	3.8	1.2	4.0	12.0	Q1
SN74AXC4T245PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74AXC4T245PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74AXC4T245RSVR	UQFN	RSV	16	3000	178.0	13.5	2.1	2.9	0.75	4.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AXC4T245BQBR	WQFN	BQB	16	3000	210.0	185.0	35.0
SN74AXC4T245PWR	TSSOP	PW	16	2000	364.0	364.0	27.0
SN74AXC4T245PWR	TSSOP	PW	16	2000	853.0	449.0	35.0
SN74AXC4T245RSVR	UQFN	RSV	16	3000	189.0	185.0	36.0



4220314/C 02/2020

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

RSV0016A

UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 25X



4220314/C 02/2020

NOTES: (continued)

3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

RSV0016A

UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 25X

4220314/C 02/2020

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



4220204/A 02/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

GENERIC PACKAGE VIEW

BQB 16

WQFN - 0.8 mm max height

2.5 x 3.5, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4226161/A



NOTES:

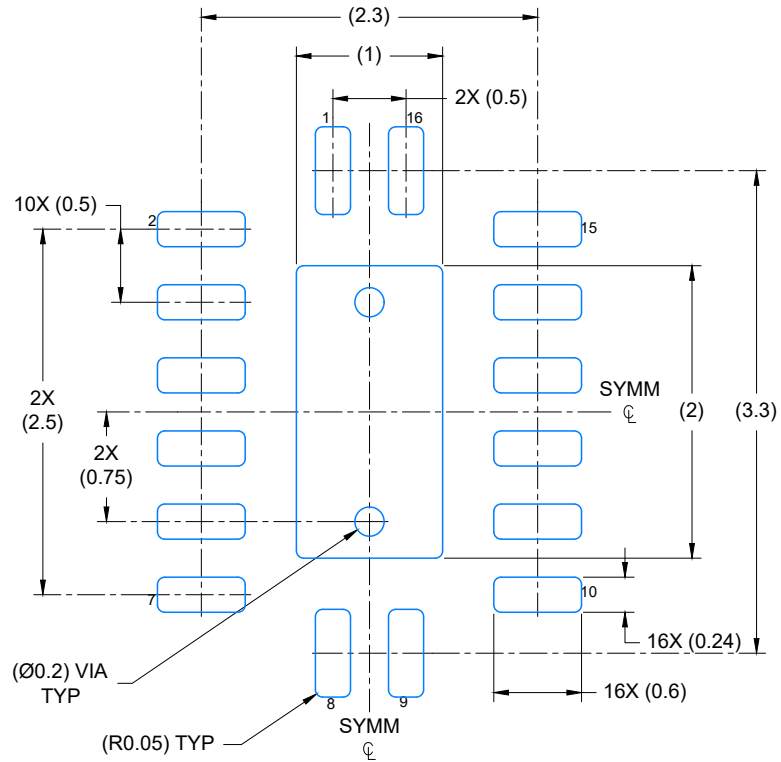
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

BQB0016A

WQFN - 0.8 mm max height

PLASTIC QUAD FLAT PACK-NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



4224640/A 11/2018

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

BQB0016A

WQFN - 0.8 mm max height

PLASTIC QUAD FLAT PACK-NO LEAD



SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
 85% PRINTED COVERAGE BY AREA
 SCALE: 20X

4224640/A 11/2018

NOTES: (continued)

- 6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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