SN74AVCH4T245-Q1 Automotive 4-Bit Dual-Supply Bus Transceiver With Configurable Level-Shifting, Voltage Translation, and 3-State Outputs

1 Features

- Control inputs V_{IH}/V_{IL} levels are referenced to V_{CCA} voltage
- Fully configurable dual-rail design allows each port to operate over the full 1.08V to 3.6V power-supply range
- I_{off} supports partial power-down-mode operation
- Bus hold on data inputs eliminates the need for external pull-up/pull-down resistors
- Supports data rate up to:
  - 500Mbps (1.08V to 3.6V translation)
- Latch-up performance exceeds 100mA per JESD 78, class II
- ESD protection exceeds JESD 22:
  - 8000V Human Body Model (A114-A)
  - 200V Machine Model (A115-A)
  - 1000V Charged-Device Model (C101)

2 Applications

- Personal electronics
- Industrial
- Enterprise
- Telecom

3 Description

This 4-bit noninverting bus transceiver uses two separate configurable power-supply rails. The A port is designed to track V_{CCA}. V_{CCA} accepts any supply voltage from 1.08V to 3.6V. The B port is designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.08V to 3.6V. The SN74AVCH4T245-Q1 is optimized to operate with V_{CCA}/V_{CCB} set at 1.08V to 3.6V. It is operational with V_{CCA}/V_{CCB} as low as 1.08V. This allows for universal low voltage bidirectional translation between any of the 1.2V, 1.5V, 1.8V, 2.5V, and 3.3V voltage nodes.

The SN74AVCH4T245-Q1 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable ($\overline{OE}$) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. The device transmits data from the A bus to the B bus when the B-port outputs are activated, and from the B bus to the A bus when the A-port outputs are activated. The input circuitry on both A and B ports is always active and must have a logic HIGH or LOW level applied to prevent excess I_{CC} and I_{CCZ}.

The SN74AVCH4T245-Q1 device control pins (1DIR, 2DIR, 1OE, and 2OE) are supplied by V_{CCA}.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

The V_{CC} isolation feature is designed so that if either V_{CC} input is at GND, then both ports are in the high-impedance state. The bus-hold circuitry on the powered-up side always stays active.

Active bus-hold circuitry holds unused or undriven data inputs at a valid logic state. Use of pull-up or pull-down resistors with the bus-hold circuitry is not recommended. The bus-hold circuitry on the powered-up side always stays active.

To put the device in the high-impedance state during power up or power down, tie the $\overline{OE}$ pin to V_{CC} through a pull-up resistor; the current-sinking capability of the driver determines the minimum value of the resistor.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
SN74AVCH4T245-Q1	PW (TSSOP, 16)	5mm × 6.4mm

(1) For more information, see Section 10.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.

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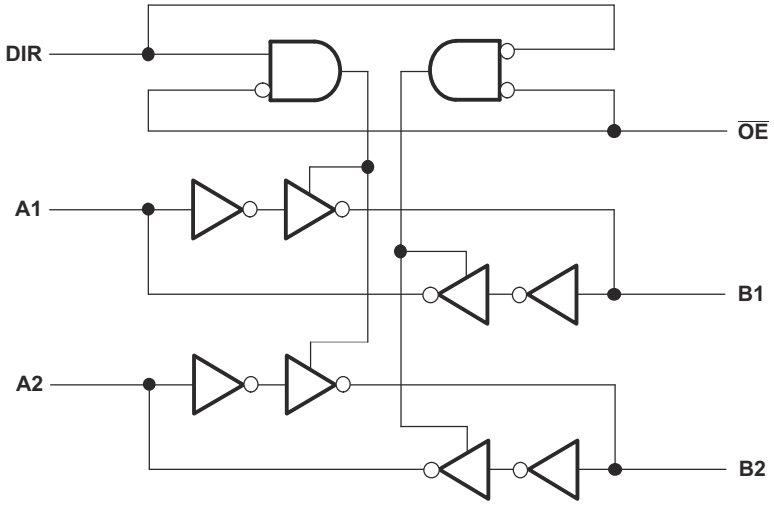

Logic Diagram (Positive Logic) for 1/2 of SN74AVCH4T245-Q1

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4 Pin Configuration and Functions

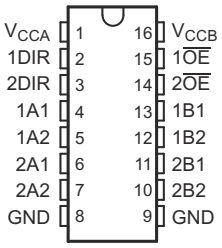

Figure 4-1. PW Package, 16-Pin TSSOP (Top View)

Table 4-1. Pin Functions

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
1A1	4	I/O	Input/output 1A1. Referenced to V_{CCA}.
1A2	5	I/O	Input/output 1A2. Referenced to V_{CCA}.
1B1	13	I/O	Input/output 1B1. Referenced to V_{CCB}.
1B2	12	I/O	Input/output 1B2. Referenced to V_{CCB}.
1DIR	2	I	Direction-control input for 1 ports
1 $\overline{OE}$	15	I	3-state output-mode enables. Pull $\overline{OE}$ high to place '1' outputs in 3-state mode. Referenced to V_{CCA}.
2A1	6	I/O	Input/output 2A1. Referenced to V_{CCA}.
2A2	7	I/O	Input/output 2A2. Referenced to V_{CCA}.
2B1	11	I/O	Input/output 2B1. Referenced to V_{CCB}.
2B2	10	I/O	Input/output 2B2. Referenced to V_{CCB}.
2DIR	3	I	Direction-control input for 2 ports
2 $\overline{OE}$	14	I	3-state output-mode enables. Pull $\overline{OE}$ high to place 2 outputs in 3-state mode. Referenced to V_{CCA}.
GND	8, 9	—	Ground
V_{CCA}	1	—	A-port power supply voltage. 1.2V ≤ V_{CCA} ≤ 3.6V
V_{CCB}	16	—	B-port power supply voltage. 1.2V ≤ V_{CCB} ≤ 3.6V

(1) I = input, O = output

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5 Specifications

5.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V_{CCA}	Supply voltage		–0.5	4.6	V
V_{CCB}	Supply voltage		–0.5	4.6	V
V_I	Input voltage(2)	I/O ports (A port)	–0.5	4.6	V
		I/O ports (B port)	–0.5	4.6	
		Control inputs	–0.5	4.6	
V_O	Voltage applied to any output in the high-impedance or power-off state(2)	A port	–0.5	4.6	V
		B port	–0.5	4.6	
V_O	Voltage applied to any output in the high or low state(2) (3)	A port	–0.5	V_{CCA} + 0.5	V
		B port	–0.5	V_{CCB} + 0.5	
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	mA
	Continuous current through V_{CCA}, V_{CCB}, or GND			±100	mA
T_{stg}	Storage temperature		–65	150	°C

(1) Operation outside the *Absolute Maximum Rating* may cause permanent device damage. *Absolute Maximum Rating* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Condition*. If used outside the *Recommended Operating Condition* but within the *Absolute Maximum Rating*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
(2) The input voltage and output negativeVoltage ratings may be exceeded if the input and output current ratings are observed.
(3) The output positiveVoltage rating may be exceeded up to 4.6V maximum if the output current rating is observed.

5.2 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	
		Machine model	±200	

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

5.3 Recommended Operating Conditions

see (1) (2) (3) (4) (5)

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.08	3.6	V
V_{CCB}	Supply voltage				1.08	3.6	V
			1.08V		V_{CCI} × 0.7		
V_{IH}	High-level input voltage	Data inputs(4)	1.1V to 1.95V		V_{CCI} × 0.65		V
			2V to 2.7V		1		
			2.8V to 3.6V		1.4		
V_{IL}	Low-level input voltage	Data inputs(4)	1.08V			V_{CCI} × 0.3	V
			1.1V to 1.95V			V_{CCI} × 0.35	
			2V to 2.7V			1.5	
			2V to 3.6V			1.9	

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5.3 Recommended Operating Conditions (continued)

see (1) (2) (3) (4) (5)

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{IH}	High-level input voltage	DIR (referenced to V_{CCA})(5)	1.08V to 1.95V		V_{CCA} × 0.65		V
			2V to 2.7V		1		
			3V to 3.6V		1.3		
V_{IL}	Low-level input voltage	DIR (referenced to V_{CCA})(5)	1.08V to 1.95V			V_{CCA} × 0.35	V
			2V to 2.7V			1.3	
			3V to 3.6V			1.7	
V_I	Input voltage				0	3.6	V
V_O	Output voltage	Active state			0	V_{CCO}	V
		3-state			0	3.6	
I_{OH}	High-level output current			1.08V to 1.32V		–3	mA
				1.4V to 1.6V		–6	
				1.65V to 1.95V		–8	
				2.3V to 2.7V		–9	
				3V to 3.6V		–12	
I_{OL}	Low-level output current			1.08V to 1.32V		3	mA
				1.4V to 1.6V		6	
				1.65V to 1.95V		8	
				2.3V to 2.7V		9	
				3V to 3.6V		12	
Δt/Δv	Input transition rise or fall rate					5	ns/V
T_A	Operating free-air temperature				–40	125	°C

(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) All unused data inputs of the device must be held at V_{CCI} or GND for proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
(4) For V_{CCI} values not specified in the data sheet, V_{IH} min = V_{CCI} × 0.7V, V_{IL} max = V_{CCI} × 0.3V.
(5) For V_{CCA} values not specified in the data sheet, V_{IH} min = V_{CCA} × 0.7V, V_{IL} max = V_{CCA} × 0.3V.

5.4 Thermal Information

THERMAL METRIC(1)		SN74AVCH4T245-Q1 PW (TSSOP) 16 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance(2)	112.0	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	46.8	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	57.1	°C/W
ψ_{JT}	Junction-to-top characterization parameter	5.7	°C/W
ψ_{JB}	Junction-to-board characterization parameter	56.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.
(2) The package thermal impedance is calculated in accordance with JESD 51-7.

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5.5 Electrical Characteristics

All typical limits apply over T_A = 25°C, and all maximum and minimum limits apply over T_A = –40°C to 125°C (unless otherwise noted).(5) (6)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OH}	I_{OH} = –100µA; V_{CCA} = 1.08V to 3.6V; V_{CCB} = 1.08V to 3.6V; V_I = V_{IH}		V_{CCO} – 0.2			V
	I_{OH} = –3mA; V_{CCA} = 1.1V; V_{CCB} = 1.1V; V_I = V_{IH}		0.8			
	I_{OH} = –6mA; V_{CCA} = 1.4V; V_{CCB} = 1.4V; V_I = V_{IH}		1.0			
	I_{OH} = –8mA; V_{CCA} = 1.65V; V_{CCB} = 1.65V; V_I = V_{IH}		1.2			
	I_{OH} = –9mA; V_{CCA} = 2.3V; V_{CCB} = 2.3V; V_I = V_{IH}		1.8			
	I_{OH} = –12mA; V_{CCA} = 3V; V_{CCB} = 3V; V_I = V_{IH}		2.3			
V_{OL}	I_{OL} = 100µA; V_{CCA} = 1.08V to 3.6V; V_{CCB} = 1.08V to 3.6V; V_I = V_{IL}				0.2	V
	I_{OL} = 3mA; V_{CCA} = 1.1V; V_{CCB} = 1.1V; V_I = V_{IL}				0.2	
	I_{OL} = 6mA; V_{CCA} = 1.4V; V_{CCB} = 1.4V; V_I = V_{IL}				0.31	
	I_{OL} = 8mA; V_{CCA} = 1.65V; V_{CCB} = 1.65V; V_I = V_{IL}				0.35	
	I_{OL} = 9mA; V_{CCA} = 2.3V; V_{CCB} = 2.3V; V_I = V_{IL}				0.33	
	I_{OL} = 12mA; V_{CCA} = 3V; V_{CCB} = 3V; V_I = V_{IL}				0.40	
I_I DIR input	V_I = V_{CCA} or GND; V_{CCA} = 1.08V to 3.6V; V_{CCB} = 1.08V to 3.6V	T_A = 25°C	-0.25		0.25	µA
		T_A = –40°C to 125°C	-1		1.5	
I_{BHL} (1)	V_I = 0.42V; V_{CCA} = 1.08V; V_{CCB} = 1.08V		9			µA
	V_I = 0.49V; V_{CCA} = 1.4V; V_{CCB} = 1.4V		19			
	V_I = 0.58V; V_{CCA} = 1.65V; V_{CCB} = 1.65V		29			
	V_I = 0.7V; V_{CCA} = 2.3V; V_{CCB} = 2.3V		53			
	V_I = 0.8V; V_{CCA} = 3.3V; V_{CCB} = 3.3V		86			
I_{BHH} (2)	V_I = 0.78V; V_{CCA} = 1.08V; V_{CCB} = 1.08V			–25		µA
	V_I = 0.91V; V_{CCA} = 1.4V; V_{CCB} = 1.4				-21	
	V_I = 1.07V; V_{CCA} = 1.65V; V_{CCB} = 1.65V				-30	
	V_I = 1.6V; V_{CCA} = 2.3V; V_{CCB} = 2.3V				-53	
	V_I = 2V; V_{CCA} = 3.3V; V_{CCB} = 3.3V				-118	
I_{BHLO} (3)	V_I = 0 to V_{CCI}	V_{CCA} = 1.32V; V_{CCB} = 1.32V			66	µA
		V_{CCA} = 1.6V; V_{CCB} = 1.6V			103	
		V_{CCA} = 1.95V; V_{CCB} = 1.95V			145	
		V_{CCA} = 2.7V; V_{CCB} = 2.7V			238	
		V_{CCA} = 3.6V; V_{CCB} = 3.6V			350	

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5.5 Electrical Characteristics (continued)

All typical limits apply over T_A = 25°C, and all maximum and minimum limits apply over T_A = –40°C to 125°C (unless otherwise noted).(5) (6)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{BHHO} (4)		V_I = 0 to V_{CCI}	V_{CCA} = 1.32V; V_{CCB} = 1.32V	-48			µA
			V_{CCA} = 1.6V; V_{CCB} = 1.6V	–80			
			V_{CCA} = 1.95V; V_{CCB} = 1.95V	–122			
			V_{CCA} = 2.7V; V_{CCB} = 2.7V	–218			
			V_{CCA} = 3.6V; V_{CCB} = 3.6V	–339			
I_{off}	A port	V_I or V_O = 0 to 3.6V; V_{CCA} = 0V; V_{CCB} = 0V to 3.6V	T_A = 25°C		±0.1	±1	µA
			T_A = –40°C to 125°C			±5	
	B port	V_I or V_O = 0 to 3.6V; V_{CCA} = 0V to 3.6V; V_{CCB} = 0V	T_A = 25°C		±0.1	±1	
			T_A = –40°C to 125°C			±5	
I_{OZ} (7)	A or B port	V_O = V_{CCO} or GND, V_I = V_{CCI} or GND; $\overline{OE}$ = V_{IH}; V_{CCA} = 3.6V; V_{CCB} = 3.6V	T_A = 25°C		±0.5	±2.5	µA
			T_A = –40°C to 125°C			±5	
	B port	V_O = V_{CCO} or GND, V_I = V_{CCI} or GND; $\overline{OE}$ = don't care; V_{CCA} = 0V; V_{CCB} = 3.6V				±5	
	A port	V_O = V_{CCO} or GND, V_I = V_{CCI} or GND; $\overline{OE}$ = don't care; V_{CCA} = 3.6V; V_{CCB} = 0V				±5	
I_{CCA}		V_I = V_{CCI} or GND, I_O = 0	V_{CCA} = 1.08V to 3.6V V_{CCB} = 1.08V to 3.6V			9	µA
			V_{CCA} = 0V; V_{CCB} = 3.6V			–2	
			V_{CCA} = 3.6V; V_{CCB} = 0V			5	
I_{CCB}		V_I = V_{CCI} or GND, I_O = 0	V_{CCA} = 1.08V to 3.6V V_{CCB} = 1.08V to 3.6V			7	µA
			V_{CCA} = 0V; V_{CCB} = 3.6V			4.5	
			V_{CCA} = 3.6V; V_{CCB} = 0V			–2	
I_{CCA} + I_{CCB}		V_I = V_{CCI} or GND, I_O = 0; V_{CCA} = 1.08V to 3.6V; V_{CCB} = 1.08V to 3.6V				16	µA
C_i	Control inputs	V_I = 3.3V or GND; V_{CCA} = 3.3V; V_{CCB} = 3.3V				4.5	pF
C_{io}	A or B port	V_O = 3.3V or GND; V_{CCA} = 3.3V; V_{CCB} = 3.3V				5.1	pF

(1) The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} maximum. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} max.
(2) The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} min.
(3) An external driver must source at least I_{BHLO} to switch this node from low to high.
(4) An external driver must sink at least I_{BHHO} to switch this node from high to low.
(5) V_{CCO} is the V_{CC} associated with the output port.
(6) V_{CCI} is the V_{CC} associated with the input port.
(7) For I/O ports, the parameter I_{OZ} includes the input leakage current.

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5.6 Switching Characteristics, V_{CCA} = 1.2V ± 0.12V

over recommended operating free-air temperature range (for parameter descriptions, see Figure 6-1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}	TYP	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB} = 1.2V ± 0.12V	3.1	ns
			V_{CCB} = 1.5V ± 0.1V	2.6	
			V_{CCB} = 1.8V ± 0.15V	2.5	
			V_{CCB} = 2.5V ± 0.2V3	3	
			V_{CCB} = 3.3V ± 0.3V	3.5	
t_{PLH}, t_{PHL}	B	A	V_{CCB} = 1.2V ± 0.12V	3.1	ns
			V_{CCB} = 1.5V ± 0.1V	2.7	
			V_{CCB} = 1.8V ± 0.15V	2.5	
			V_{CCB} = 2.5V ± 0.2V	2.4	
			V_{CCB} = 3.3V ± 0.3V	2.3	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V	5.3	ns
			V_{CCB} = 1.5V ± 0.1V	5.3	
			V_{CCB} = 1.8V ± 0.15V	5.3	
			V_{CCB} = 2.5V ± 0.2V	5.3	
			V_{CCB} = 3.3V ± 0.3V	5.3	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V	5.1	ns
			V_{CCB} = 1.5V ± 0.1V	4	
			V_{CCB} = 1.8V ± 0.15V	3.5	
			V_{CCB} = 2.5V ± 0.2V	3.2	
			V_{CCB} = 3.3V ± 0.3V	3.1	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V	4.8	ns
			V_{CCB} = 1.5V ± 0.1V	4.8	
			V_{CCB} = 1.8V ± 0.15V	4.8	
			V_{CCB} = 2.5V ± 0.2V	4.8	
			V_{CCB} = 3.3V ± 0.3V	4.8	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V	4.7	ns
			V_{CCB} = 1.5V ± 0.1V	4	
			V_{CCB} = 1.8V ± 0.15V	4.1	
			V_{CCB} = 2.5V ± 0.2V	4.3	
			V_{CCB} = 3.3V ± 0.3V	5.1	

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5.7 Switching Characteristics, V_{CCA} = 1.5V ± 0.1V

over temperature range -40 °C to +125 °C (for parameter descriptions, see Figure 6-1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PHL}, t_{PLH}	A	B	V_{CCB} = 1.2V ± 0.12V		4.2		ns
			V_{CCB} = 1.5V ± 0.1V	2.2		5.7	
			V_{CCB} = 1.8V ± 0.15V	2.0		4.7	
			V_{CCB} = 2.5V ± 0.2V	1.7		3.8	
			V_{CCB} = 3.3V ± 0.3V	1.5		3.4	
t_{PLH}, t_{PHL}	B	A	V_{CCB} = 1.2V ± 0.12V		4.6		ns
			V_{CCB} = 1.5V ± 0.1V	2.1		5.7	
			V_{CCB} = 1.8V ± 0.15V	1.9		5.1	
			V_{CCB} = 2.5V ± 0.2V	1.7		4.2	
			V_{CCB} = 3.3V ± 0.3V	1.6		3.8	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		5.8		ns
			V_{CCB} = 1.5V ± 0.1V	3.8		10.6	
			V_{CCB} = 1.8V ± 0.15V	3.8		10.7	
			V_{CCB} = 2.5V ± 0.2V	3.7		10.6	
			V_{CCB} = 3.3V ± 0.3V	3.7		10.5	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		8.7		ns
			V_{CCB} = 1.5V ± 0.1V	3.9		10.8	
			V_{CCB} = 1.8V ± 0.15V	3.5		9.5	
			V_{CCB} = 2.5V ± 0.2V	3.2		8.3	
			V_{CCB} = 3.3V ± 0.3V	3.1		8.0	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		5.6		ns
			V_{CCB} = 1.5V ± 0.1V	3.9		9.4	
			V_{CCB} = 1.8V ± 0.15V	3.9		9.4	
			V_{CCB} = 2.5V ± 0.2V	3.9		9.4	
			V_{CCB} = 3.3V ± 0.3V	3.9		9.4	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		8.6		ns
			V_{CCB} = 1.5V ± 0.1V	4.6		11.0	
			V_{CCB} = 1.8V ± 0.15V	4.6		10.6	
			V_{CCB} = 2.5V ± 0.2V	3.7		8.9	
			V_{CCB} = 3.3V ± 0.3V	4.2		9.4	

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5.8 Switching Characteristics, V_{CCA} = 1.8V ± 0.15V

over temperature range -40 °C to +125 °C (for parameter descriptions, see Figure 6-1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB} = 1.2V ± 0.12V		3.8		ns
			V_{CCB} = 1.5V ± 0.1V	2.1		5.1	
			V_{CCB} = 1.8V ± 0.15V	2.0		4.2	
			V_{CCB} = 2.5V ± 0.2V	1.6		3.1	
			V_{CCB} = 3.3V ± 0.3V	1.4		2.9	
t_{PLH}, t_{PHL}	B	A	V_{CCB} = 1.2V ± 0.12V		4.2		ns
			V_{CCB} = 1.5V ± 0.1V	2.2		4.7	
			V_{CCB} = 1.8V ± 0.15V	2.0		4.2	
			V_{CCB} = 2.5V ± 0.2V	1.8		3.7	
			V_{CCB} = 3.3V ± 0.3V	1.7		3.3	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		4.5		ns
			V_{CCB} = 1.5V ± 0.1V	3.4		7.7	
			V_{CCB} = 1.8V ± 0.15V	3.4		7.7	
			V_{CCB} = 2.5V ± 0.2V	3.3		7.7	
			V_{CCB} = 3.3V ± 0.3V	3.4		7.6	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		8.0		ns
			V_{CCB} = 1.5V ± 0.1V	3.9		9.1	
			V_{CCB} = 1.8V ± 0.15V	3.4		7.9	
			V_{CCB} = 2.5V ± 0.2V	3.0		6.6	
			V_{CCB} = 3.3V ± 0.3V	2.9		6.2	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		5.3		ns
			V_{CCB} = 1.5V ± 0.1V	4.1		7.9	
			V_{CCB} = 1.8V ± 0.15V	4.1		8.0	
			V_{CCB} = 2.5V ± 0.2V	4.1		8.0	
			V_{CCB} = 3.3V ± 0.3V	4.1		8.0	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		7.7		ns
			V_{CCB} = 1.5V ± 0.1V	4.5		9.4	
			V_{CCB} = 1.8V ± 0.15V	4.6		9.1	
			V_{CCB} = 2.5V ± 0.2V	3.9		7.6	
			V_{CCB} = 3.3V ± 0.3V	4.3		8.1	

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5.9 Switching Characteristics, V_{CCA} = 2.5V ± 0.2V

over temperature range -40 °C to +125 °C (for parameter descriptions, see Figure 6-1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB} = 1.2V ± 0.12V		3.3		ns
			V_{CCB} = 1.5V ± 0.1V	1.9		4.2	
			V_{CCB} = 1.8V ± 0.15V	1.8		3.7	
			V_{CCB} = 2.5V ± 0.2V	1.5		2.6	
			V_{CCB} = 3.3V ± 0.3V	1.3		2.3	
t_{PLH}, t_{PHL}	B	A	V_{CCB} = 1.2V ± 0.12V		3.6		ns
			V_{CCB} = 1.5V ± 0.1V	1.8		3.8	
			V_{CCB} = 1.8V ± 0.15V	1.6		3.1	
			V_{CCB} = 2.5V ± 0.2V	1.5		2.6	
			V_{CCB} = 3.3V ± 0.3V	1.5		2.5	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		3.0		ns
			V_{CCB} = 1.5V ± 0.1V	2.5		4.8	
			V_{CCB} = 1.8V ± 0.15V	2.5		4.8	
			V_{CCB} = 2.5V ± 0.2V	2.5		4.8	
			V_{CCB} = 3.3V ± 0.3V	2.5		4.8	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		7.0		ns
			V_{CCB} = 1.5V ± 0.1V	3.5		7.4	
			V_{CCB} = 1.8V ± 0.15V	3.1		6.1	
			V_{CCB} = 2.5V ± 0.2V	2.6		4.9	
			V_{CCB} = 3.3V ± 0.3V	2.4		4.4	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		3.7		ns
			V_{CCB} = 1.5V ± 0.1V	3.1		5.3	
			V_{CCB} = 1.8V ± 0.15V	3.2		5.4	
			V_{CCB} = 2.5V ± 0.2V	3.1		5.4	
			V_{CCB} = 3.3V ± 0.3V	3.1		5.4	
t_{PHZ}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		4.5		ns
			V_{CCB} = 1.5V ± 0.1V	1.5		9.4	
			V_{CCB} = 1.8V ± 0.15V	1.3		8.2	
			V_{CCB} = 2.5V ± 0.2V	1.1		6.2	
			V_{CCB} = 3.3V ± 0.3V	0.9		5.2	
t_{PLZ}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		6.6		ns
			V_{CCB} = 1.5V ± 0.1V	4.1		7.4	
			V_{CCB} = 1.8V ± 0.15V	4.2		7.3	
			V_{CCB} = 2.5V ± 0.2V	3.5		6.0	
			V_{CCB} = 3.3V ± 0.3V	4.0		6.6	

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5.10 Switching Characteristics, V_{CCA} = 3.3V ± 0.3V

over temperature range -40 °C to +125 °C (for parameter descriptions, see Figure 6-1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB} = 1.2V ± 0.12V		3.2		ns
			V_{CCB} = 1.5V ± 0.1V	1.8		3.8	
			V_{CCB} = 1.8V ± 0.15V	1.7		3.3	
			V_{CCB} = 2.5V ± 0.2V	1.5		2.5	
			V_{CCB} = 3.3V ± 0.3V	1.2		2.0	
t_{PLH}, t_{PHL}	B	A	V_{CCB} = 1.2V ± 0.12V		3.4		ns
			V_{CCB} = 1.5V ± 0.1V	1.7		3.4	
			V_{CCB} = 1.8V ± 0.15V	1.5		2.9	
			V_{CCB} = 2.5V ± 0.2V	1.3		2.9	
			V_{CCB} = 3.3V ± 0.3V	1.2		2.0	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		2.4		ns
			V_{CCB} = 1.5V ± 0.1V	2.2		3.6	
			V_{CCB} = 1.8V ± 0.15V	2.2		3.6	
			V_{CCB} = 2.5V ± 0.2V	2.2		3.6	
			V_{CCB} = 3.3V ± 0.3V	2.2		3.6	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		6.7		ns
			V_{CCB} = 1.5V ± 0.1V	3.2		6.7	
			V_{CCB} = 1.8V ± 0.15V	2.8		5.4	
			V_{CCB} = 2.5V ± 0.2V	2.4		4.2	
			V_{CCB} = 3.3V ± 0.3V	2.2		3.7	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB} = 1.2V ± 0.12V		4.0		ns
			V_{CCB} = 1.5V ± 0.1V	3.5		5.5	
			V_{CCB} = 1.8V ± 0.15V	3.5		5.5	
			V_{CCB} = 2.5V ± 0.2V	3.4		5.4	
			V_{CCB} = 3.3V ± 0.3V	3.5		5.4	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB} = 1.2V ± 0.12V		6.3		ns
			V_{CCB} = 1.5V ± 0.1V	4.0		6.6	
			V_{CCB} = 1.8V ± 0.15V	4.0		6.5	
			V_{CCB} = 2.5V ± 0.2V	3.3		5.3	
			V_{CCB} = 3.3V ± 0.3V	3.7		5.9	

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5.11 Operating Characteristics

T_A = 25°C

PARAMETER			TEST CONDITIONS	V_{CCA}	TYP	UNIT
C_{pdA} (1)	A to B	Outputs enabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	1	pF
				V_{CCA} = V_{CCB} = 1.5V	1	
				V_{CCA} = V_{CCB} = 1.8V	1	
				V_{CCA} = V_{CCB} = 2.5V	1.5	
				V_{CCA} = V_{CCB} = 3.3V	2	
		Outputs disabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	1	pF
				V_{CCA} = V_{CCB} = 1.5V	1	
				V_{CCA} = V_{CCB} = 1.8V	1	
				V_{CCA} = V_{CCB} = 2.5V	1	
				V_{CCA} = V_{CCB} = 3.3V	1	
	B to A	Outputs enabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	12	pF
				V_{CCA} = V_{CCB} = 1.5V	12.5	
				V_{CCA} = V_{CCB} = 1.8V	13	
				V_{CCA} = V_{CCB} = 2.5V	14	
				V_{CCA} = V_{CCB} = 3.3V	15	
		Outputs disabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	1	pF
				V_{CCA} = V_{CCB} = 1.5V	1	
				V_{CCA} = V_{CCB} = 1.8V	1	
				V_{CCA} = V_{CCB} = 2.5V	1	
				V_{CCA} = V_{CCB} = 3.3V	1	
C_{pdB} (1)	A to B	Outputs enabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	12	pF
				V_{CCA} = V_{CCB} = 1.5V	12.5	
				V_{CCA} = V_{CCB} = 1.8V	13	
				V_{CCA} = V_{CCB} = 2.5V	14	
				V_{CCA} = V_{CCB} = 3.3V	15	
		Outputs disabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	1	pF
				V_{CCA} = V_{CCB} = 1.5V	1	
				V_{CCA} = V_{CCB} = 1.8V	1	
				V_{CCA} = V_{CCB} = 2.5V	1	
				V_{CCA} = V_{CCB} = 3.3V	1	
	B to A	Outputs enabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	1	pF
				V_{CCA} = V_{CCB} = 1.5V	1	
				V_{CCA} = V_{CCB} = 1.8V	1	
				V_{CCA} = V_{CCB} = 2.5V	1	
				V_{CCA} = V_{CCB} = 3.3V	2	
		Outputs disabled	C_L = 0, f = 10MHz, t_r = t_f = 1ns	V_{CCA} = V_{CCB} = 1.2V	1	pF
				V_{CCA} = V_{CCB} = 1.5V	1	
				V_{CCA} = V_{CCB} = 1.8V	1	
				V_{CCA} = V_{CCB} = 2.5V	1	
				V_{CCA} = V_{CCB} = 3.3V	1	

(1) Power dissipation capacitance per transceiver. Refer to TI application report, CMOS Power Consumption and Cpd Calculation (SCAA035)

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5.12 Typical Characteristics

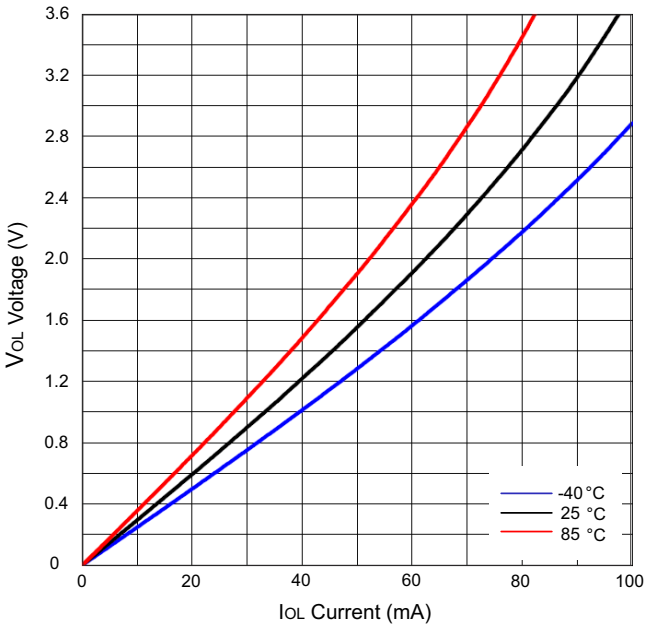

Figure 5-1. Low-Level Output Voltage (V_{OL}) vs Low-Level Current (I_{OL})

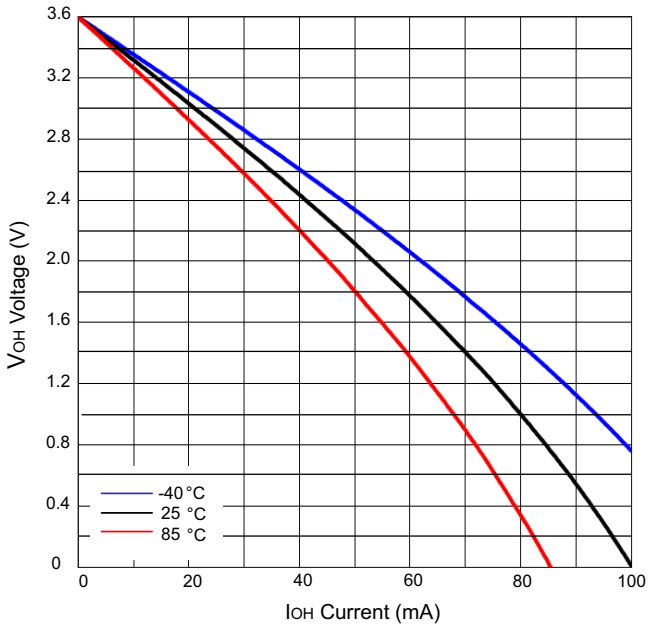

Figure 5-2. High-Level Output Voltage (V_{OH}) vs High-Level Current (I_{OH})

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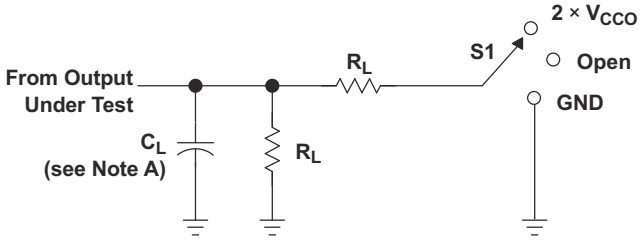
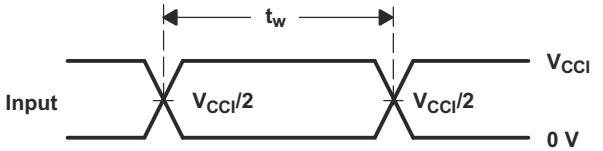
6 Parameter Measurement Information



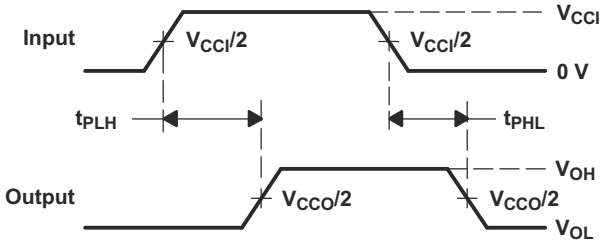
TEST	S1
t_{pd} t_{PLZ}/t_{PZL} t_{PHZ}/t_{PZH}	Open 2 × V_{CCO} GND

LOAD CIRCUIT

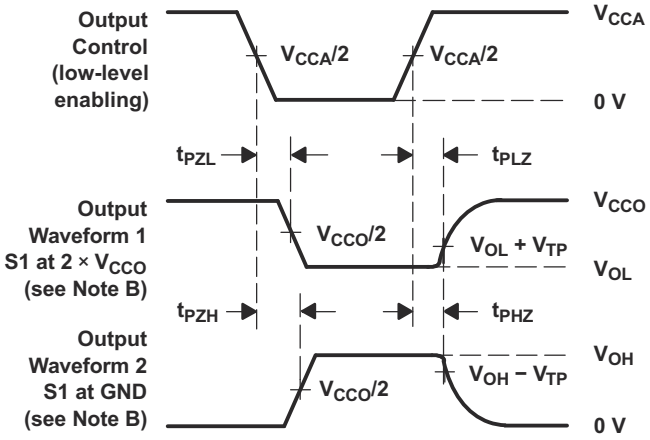
V_{CCO}	C_L	R_L	V_{TP}
1.2 V	15 pF	2 kΩ	0.1 V
1.5 V ± 0.1 V	15 pF	2 kΩ	0.1 V
1.8 V ± 0.15 V	15 pF	2 kΩ	0.15 V
2.5 V ± 0.2 V	15 pF	2 kΩ	0.15 V
3.3 V ± 0.3 V	15 pF	2 kΩ	0.3 V



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES:
A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: PRR 10 MHz, Z_O = 50 Ω, dv/dt ≥ 1 V/ns, dv/dt ≥1 V/ns.
D. The outputs are measured one at a time, with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.
H. V_{CCI} is the V_{CC} associated with the input port.
I. V_{CCO} is the V_{CC} associated with the output port.

Figure 6-1. Load Circuit and Voltage Waveforms

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7 Detailed Description

7.1 Overview

The SN74AVCH4T245-Q1 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 supported by V_{CCA}, and Bx pins are supported by V_{CCB}. The A port can accept I/O voltages ranging from 1.08V to 3.6V, while the B port can accept I/O voltages from 1.08V to 3.6V. A high on DIR allows data transmission from Ax to Bx and a low on DIR allows data transmission from Bx to Ax 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. For more information, refer to the *AVC Logic Family Technology and Applications* application report.

7.2 Functional Block Diagram

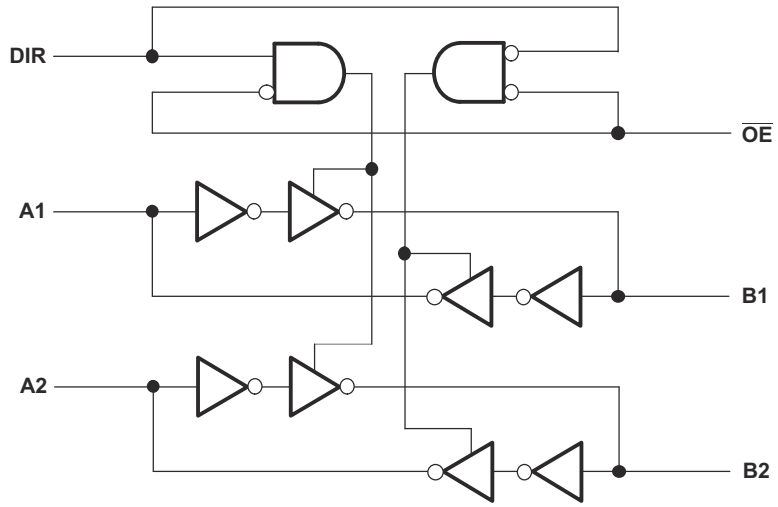

Figure 7-1. Logic Diagram (Positive Logic) for 1/2 of SN74AVCH4T245-Q1

7.3 Feature Description

7.3.1 Fully Configurable Dual-Rail Design

Fully configurable dual-rail design allows each port to operate over the full 1.08V to 3.6V power-supply range.

Both V_{CCA} and V_{CCB} can be supplied at any voltage between 1.08V and 3.6V; thus, making the device an excellent choice for translating between any of the low voltage nodes (1.2V, 1.8V, 2.5V, and 3.3V).

7.3.2 Supports High Speed Translation

The SN74AVCH4T245-Q1 device can support high data rate applications. The translated signal data rate can be up to 500Mbps when the signal is translated from 1.08V to 3.3V.

7.3.3 I_{off} Supports Partial-Power-Down Mode Operation

I_{off} will prevent backflow current by disabling I/O output circuits when device is in partial-power-down mode.

7.3.4 Bus-Hold Circuitry

This device has active bus-hold circuitry that holds unused or undriven inputs at a valid logic state. Use of pull-up or pull-down resistors with the bus-hold circuitry is not recommended. (Refer to the *Bus-Hold Circuit* application report. Pullup and pulldown resistors are not recommended on the inputs of devices with bus-hold. Unused inputs can be left floating.

7.3.5 Vcc Isolation Feature

The VCC isolation feature is designed so that if either V_{CCA} or V_{CCB} are at GND (or < 0.4V), both ports will be in a high-impedance state (IOZ shown in *Section 5.5*). This prevents false logic levels from being presented to either bus.

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7.4 Device Functional Modes

Table 7-1 lists the functional modes of the SN74AVCH4T245-Q1.

Table 7-1. Function Table (Each 2-Bit Section)

CONTROL INPUTS(1)		OUTPUT CIRCUITS		OPERATION
$\overline{OE}$	DIR	A PORT	B PORT	
L	L	Enabled	Hi-Z	B data to A bus
L	H	Hi-Z	Enabled	A data to B bus
H	X	Hi-Z	Hi-Z	Isolation

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

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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.

8.1 Application Information

The SN74AVCH4T245-Q1 device can be used in level-shifting applications for interfacing devices or systems operating at different interface voltages with one another. The SN74AVCH4T245-Q1 device is an excellent choice for applications where a push-pull driver is connected to the data I/Os. The maximum data rate can be up to 500Mbps when device translates a signal from 1.08V to 3.3V.

8.2 Typical Application

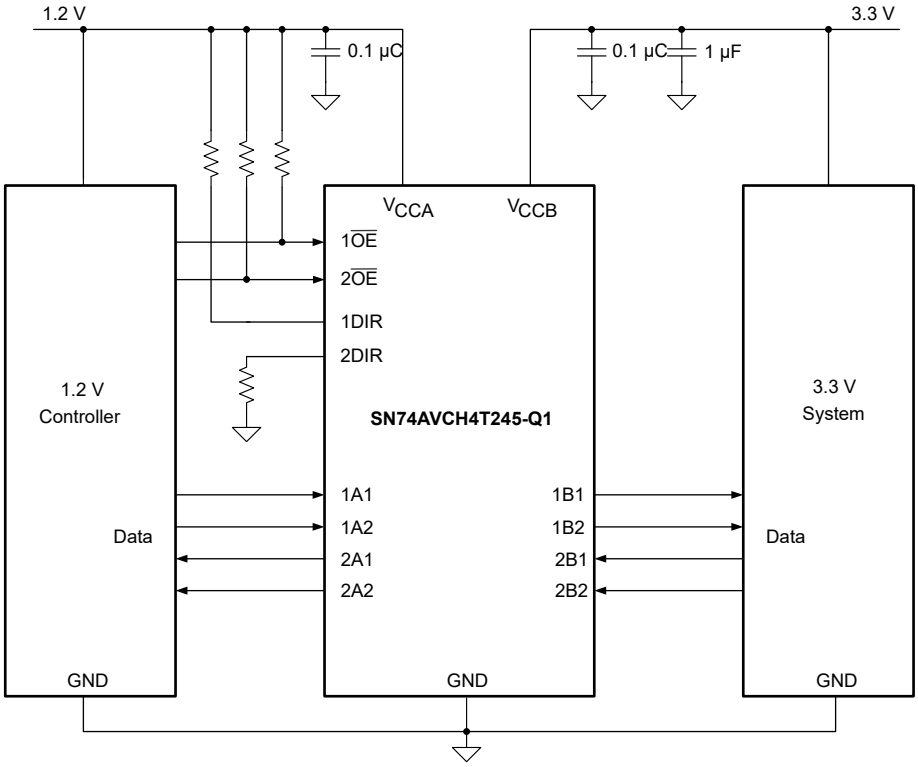

Figure 8-1. Typical Application Diagram

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8.2.1 Design Requirements

For the design example shown in Section 8.2 use the parameters listed in Table 8-1.

Table 8-1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage range	1.08V to 3.6V
Output voltage range	1.08V to 3.6V

8.2.2 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 SN74AVCH4T245-Q1 device to determine the input voltage range. For a valid logic high, the value must exceed the V_{IH} of the input port. For a valid logic low, the value must be less than the V_{IL} of the input port.
- Output voltage range
  - Use the supply voltage of the device that the SN74AVCH4T245-Q1 device is driving to determine the output voltage range.

8.2.3 Application Curve

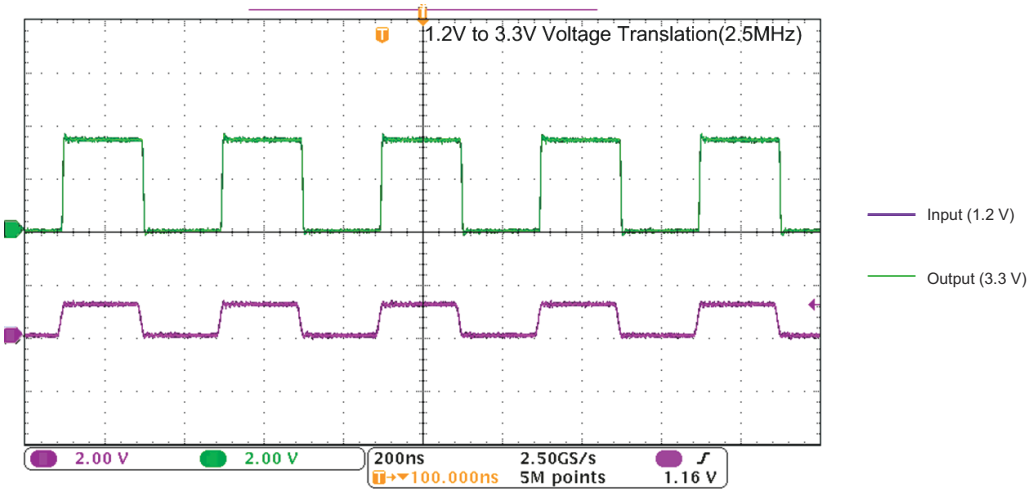

Figure 8-2. Translation Up (1.2V to 3.3V) at 2.5MHz

8.3 Power Supply Recommendations

The SN74AVCH4T245-Q1 device uses two separate configurable power-supply rails, V_{CCA} and V_{CCB}. V_{CCA} accepts any supply voltage from 1.08V to 3.6V, and V_{CCB} accepts any supply voltage from 1.08V to 3.6V. The A port and B port are designed to track V_{CCA} and V_{CCB} respectively allowing for low voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V, and 3.3-V voltage nodes.

The output-enable ($\overline{OE}$) input circuit is designed so that it is supplied by V_{CCA}, and all outputs are placed in the high-impedance state when the $\overline{OE}$ input is high. To put the outputs in the high-impedance state during power up or power down, the $\overline{OE}$ input pin must be tied to V_{CCA} through a pull-up resistor and must not be enabled until V_{CCA} and V_{CCB} are fully ramped and stable. The current-sinking capability of the driver determines the minimum value of the pull-up resistor to V_{CCA}.

V_{CCA} or V_{CCB} can be powered up first. If the SN74AVCH4T245-Q1 is powered up in a permanently enabled state, pull-up resistors are recommended at the input. This allows for proper or glitch-free power-up. For more information, refer to *Designing with SN74LVCXT245 and SN74LVCHXT245 Family of Direction Controlled Voltage Translators/Level-Shifters* application note.

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8.4 Layout

8.4.1 Layout Guidelines

For device reliability, it is recommended to follow common printed-circuit board layout guidelines such as:

- Use bypass capacitors on power supplies.
- Use short trace lengths to avoid excessive loading.
- Place pads on the signal paths for loading capacitors or pull-up resistors to help adjust rise and fall times of signals, depending on the system requirements.

8.4.2 Layout Example

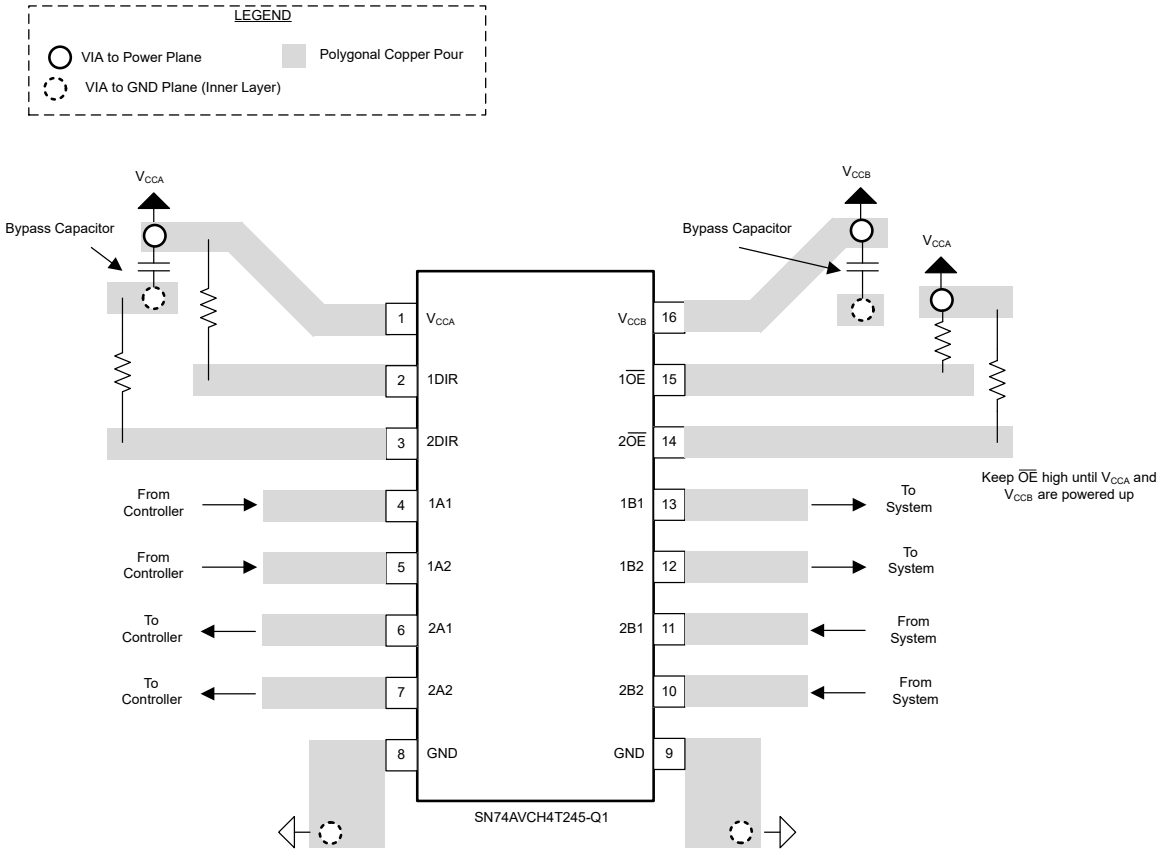

Figure 8-3. Layout Recommendation

ADVANCE INFORMATION

8 Device and Documentation Support

8.1 Documentation Support

8.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, *Designing with SN74LVCXT245 and SN74LVCHXT245 Family of Direction Controlled Voltage Translators/Level-Shifters*
- Texas Instruments, *Bus-Hold Circuit*
- Texas Instruments, *AVC Logic Family Technology and Applications*

8.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* 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.

8.3 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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8.5 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.

8.6 Glossary

TI Glossary — This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

DATE	REVISION	NOTES
February 2024	*	Initial Release

10 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.

ADVANCE INFORMATION

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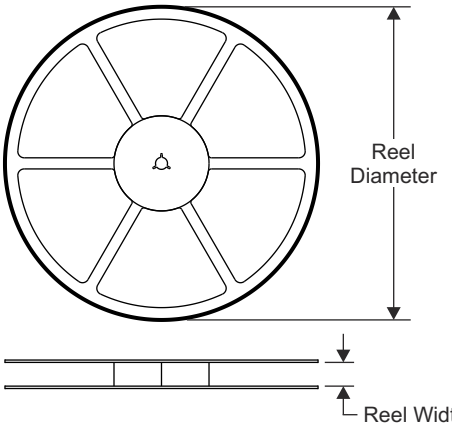
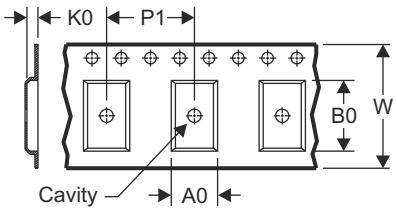
10.1 Tape and Reel Information

REEL DIMENSIONS

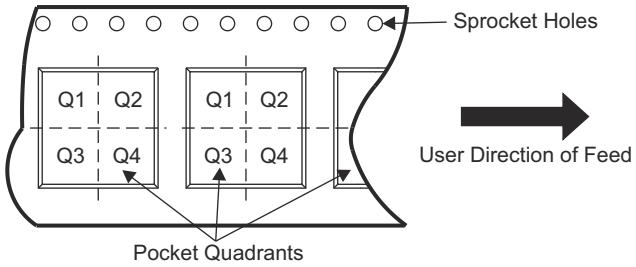


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
SN74AVC4T245PWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74AVC4T245PWTQ1	TSSOP	PW	16	250	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

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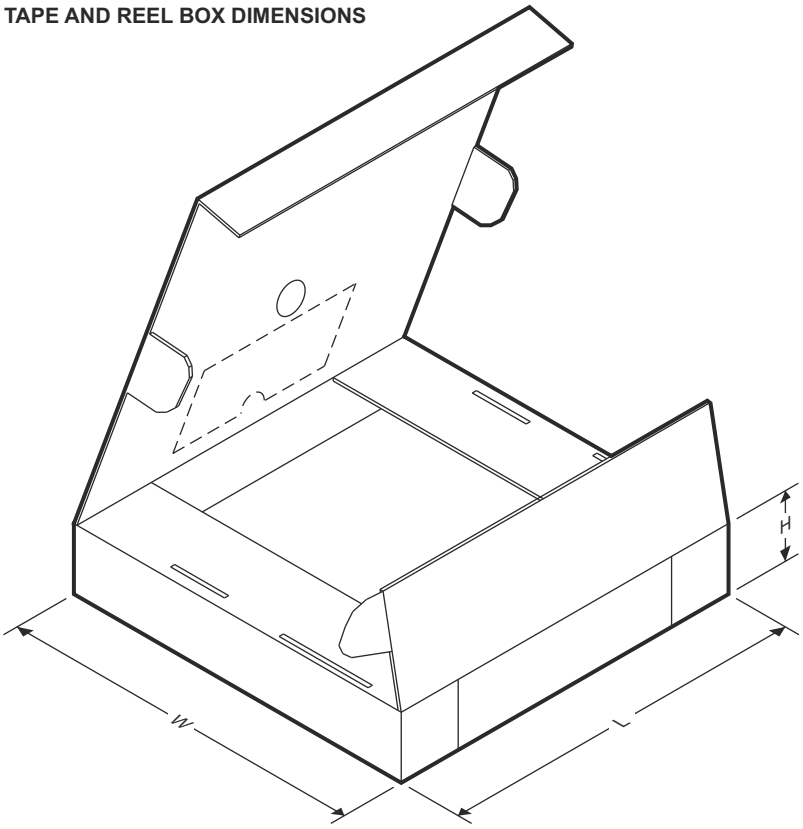
TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AVC4T245PWRQ1	TSSOP	PW	16	2000	356.0	356.0	35.0
SN74AVC4T245PWTQ1	TSSOP	PW	16	250	356.0	356.0	35.0

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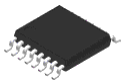
10.2 Mechanical Data

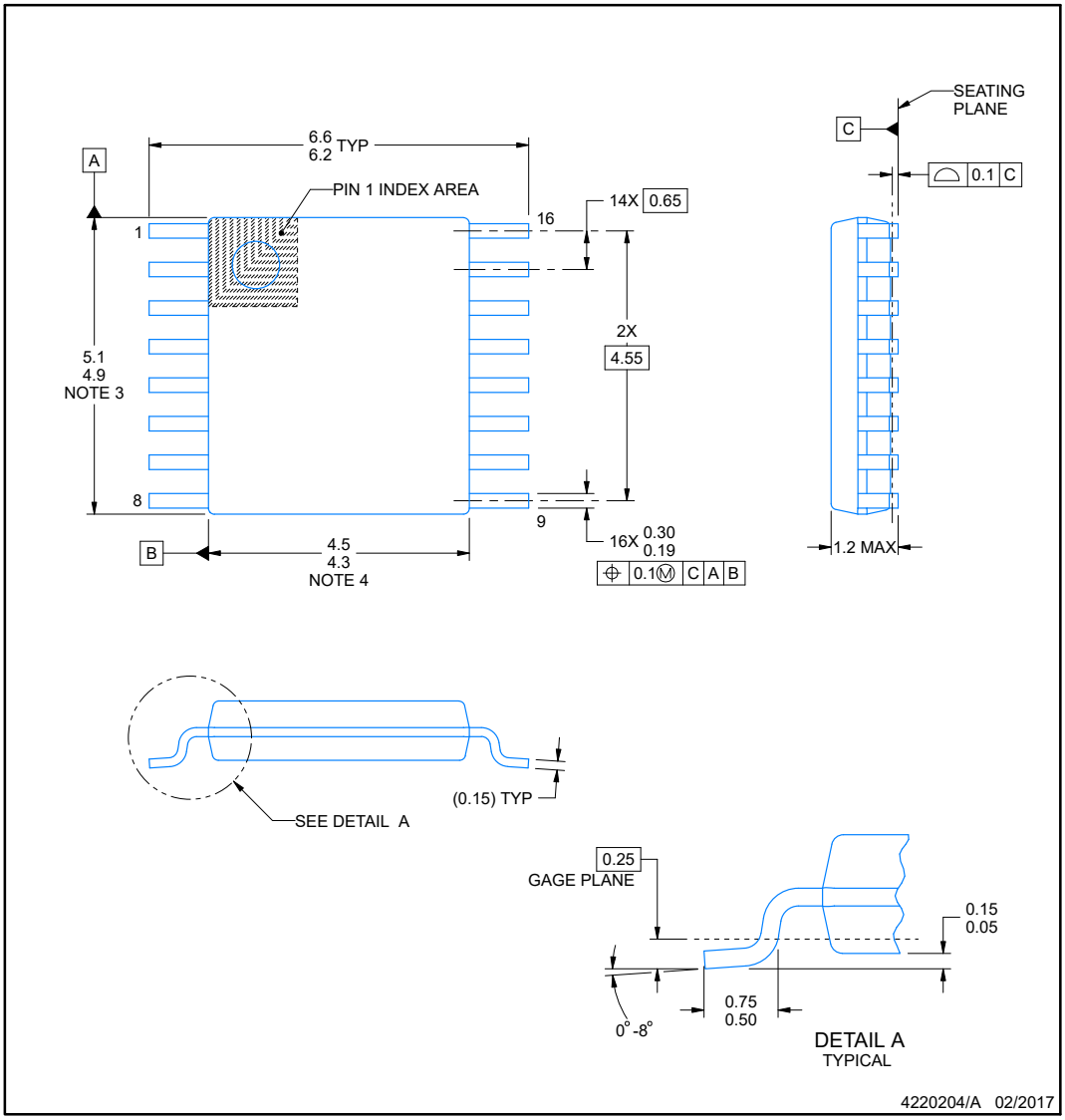
PW0016A



PACKAGE OUTLINE

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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.

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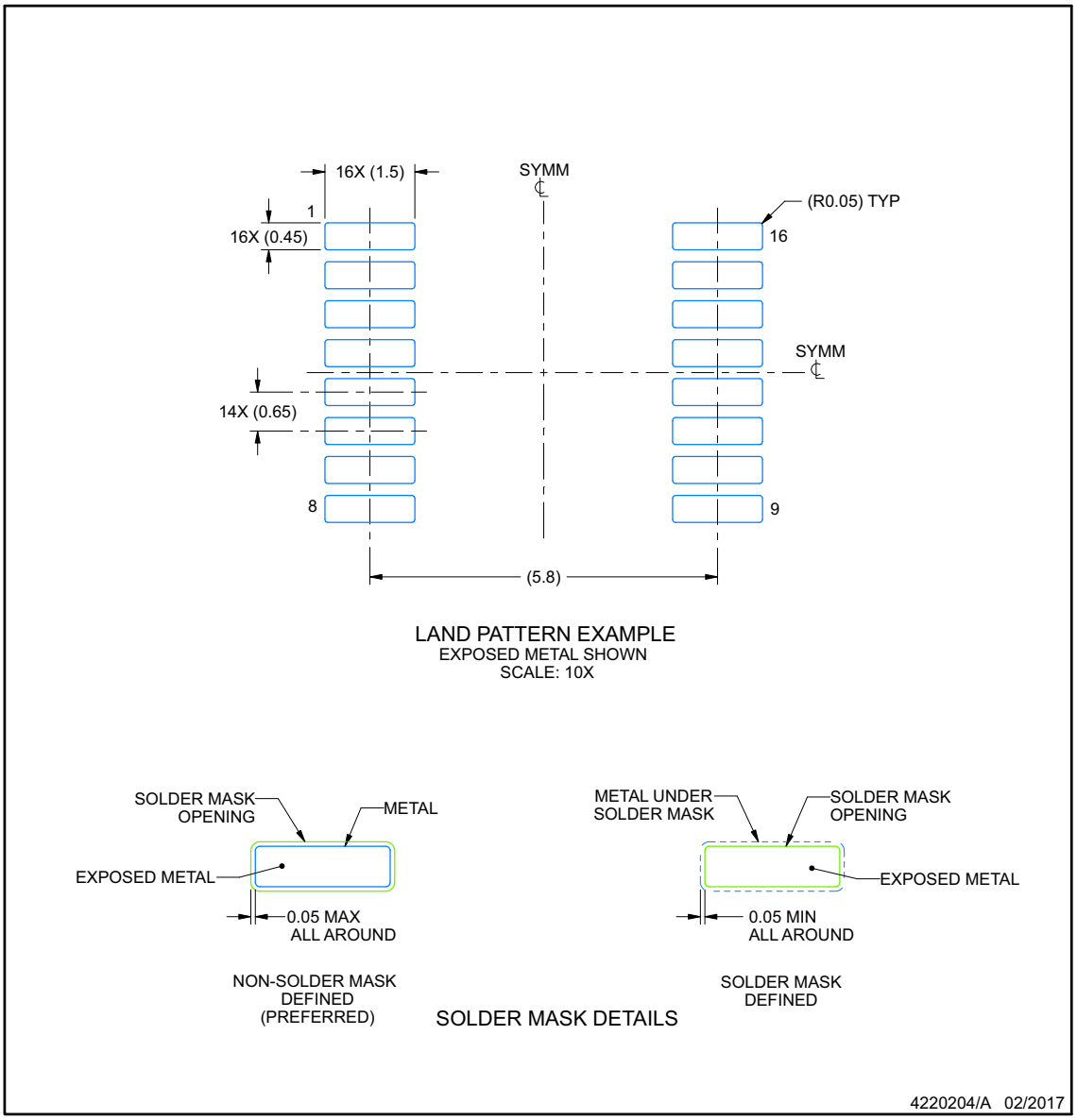
ADVANCE INFORMATION

EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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.

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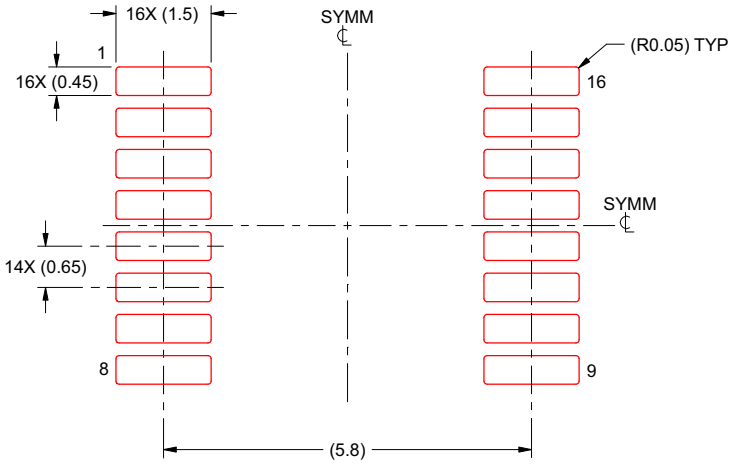
EXAMPLE STENCIL DESIGN

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.

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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
74AVCH4T245QPWRQ1	ACTIVE	TSSOP	PW	16	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	WS245Q	Samples
P74AVCH4T245QPWRQ1	ACTIVE	TSSOP	PW	16	3000	TBD	Call TI	Call TI	-40 to 125		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 SN74AVCH4T245-Q1 :

- Catalog : SN74AVCH4T245
- Enhanced Product : SN74AVCH4T245-EP

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

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