

## 16-Bit 0.8V to 2.7V Scaled Configurable Level Shifting Transceiver with 3-State Outputs

### Features

- PI74AUC164245 is designed for low voltage operation: 0.8V to 2.7V
- $I_{OFF}$  supports partial Power-Down mode operation
- Drive Capability 16mA @ 2.5V
- Each supply rail is configurable over supply range
- ESD Protection exceeds JESD22
  - 2000V Human Body Model (A114-B)
  - 200V Machine Model (A115-A)
- Latch-up performance exceeds 100mA per JESD 78
- Industrial operation at  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Packaging (Pb-free & Green available):
  - 48-pin plastic 240-mil TSSOP (A)
  - 48-pin plastic 173-mil TVSOP (K)

### Description

The PI74AUC164245 is a 16-bit (dual-octal) noninverting bus transceiver that contains two separate supply rails. B port ( $V_{CCB}$ ) set to operate at 0.8 to 2.5V and A port ( $V_{CCA}$ ) set to operate at 0.8 to 2.5V. This arrangement permits universal bidirectional translation over the voltage ranges.

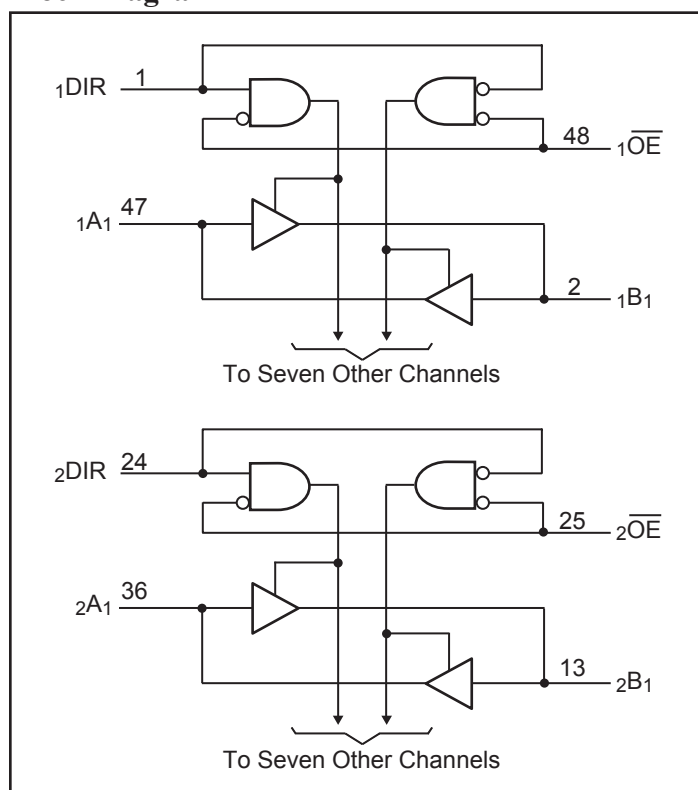
The PI74AUC164245 is designed for asynchronous communication between data buses. Data is transmitted from the A bus to the B bus or vice versa, depending on the logic level at the direction control ( $\overline{\text{DIR}}$ ) input. The output-enable ( $\overline{\text{OE}}$ ) input is used to disable outputs so buses are isolated.

The control pins,  $_1\text{DIR}$ ,  $_2\text{DIR}$ ,  $_1\overline{\text{OE}}$  and  $_2\overline{\text{OE}}$  are supplied by  $V_{CCA}$ .

The 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.

To ensure the high impedance state during power up or power down, the output-enable ( $\text{OE}$ ) input should be tied to  $V_{CC}$  through a pullup resistor, the minimum value of the resistor is determined by the current-sinking capability of the driver.

### Block Diagram



### Maximum Ratings<sup>(1)</sup>

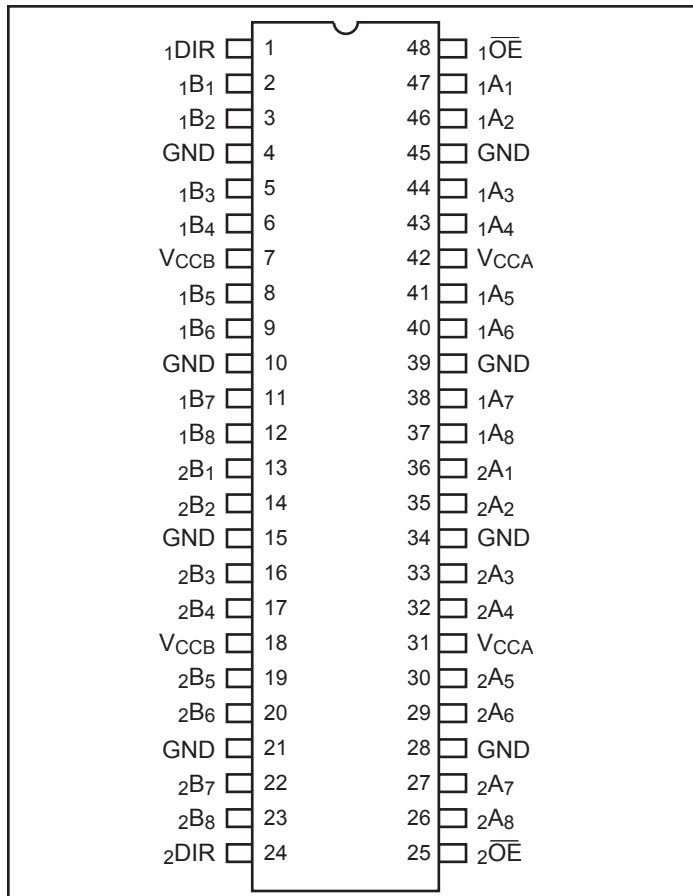
(Absolute maximum ratings over operating free-air temperature range (unless otherwise noted))

Supply voltage range: $V_{CCA}$ and $V_{CCB}$ ..... -0.5V to 3.6V Input Voltage Range, $V_I$ <sup>(2)</sup> : I/O port A ..... -0.5V to 3.6V I/O port B ..... -0.5V to 3.6V Control Inputs ..... -0.5V to 3.6V  Voltage Range applied to any output in the high-impedance or Power-Off state, $V_O$ <sup>(2)</sup> : (A Port) ..... -0.5V to 3.6V (B Port) ..... -0.5V to 3.6V  Voltage Range applied to any output in the high or Low state $V_O$ <sup>(3)</sup> : (A Port) ..... -0.5V to $V_{CCA} + 0.5V$ (B Port) ..... -0.5V to $V_{CCB} + 0.5V$	Input clamp current, $I_{IK}$ ( $V_I < 0$ )..... -50mA Output clamp current, $I_{OK}$ ( $V_O < 0$ )..... -50mA Continuous output current, $I_O$ ..... $\pm 20mA$ Continuous current through $V_{CCA}$ , $V_{CCB}$ or GND ..... $\pm 100mA$ Package thermal impedance, $\theta_{JA}$ <sup>(4)</sup> : A package ..... 104°C/W K package ..... 107°C/W Storage temperature range, $T_{STG}$ ..... -65°C to 150°C
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#### Notes:

1. Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. The input negative voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
3. This value is limited to 3.6V max.
4. The package thermal impedance is calculated in accordance with JESD 51.

### Pin Configuration



### Pin Description

Pin Name	Description
$\overline{xOE}$	3-State Output Enable Inputs (Active LOW)
$\overline{xDIR}$	Direction Control Input
$\overline{xAX}$	Side A Inputs or 3-state Outputs
$\overline{xBX}$	Side B Inputs or 3-state Outputs
GND	Ground
VCC	Power

### Truth Table (each 8-bit section)

Inputs		Operation
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Z (Isolation)

#### Notes:

H = HIGH Signal Level, L = LOW Signal Level,  
 X = Don't Care or Irrelevant, Z = High Impedance

**Recommended Operating Conditions<sup>(1)</sup>**

Parameter	Description		V <sub>CCI</sub> <sup>(2)</sup>	V <sub>CCO</sub> <sup>(3)</sup>	Min.	Max.	Units
V <sub>CCA</sub>	Supply Voltage				0.8	2.7	V
V <sub>CCB</sub>	Supply Voltage				0.8	2.7	
V <sub>IH</sub>	High-Level Input Voltage	Data Inputs	0.8V		V <sub>CCI</sub>		
			1.1V to 1.95V		0.65 x V <sub>CCI</sub>		
			2.3V to 2.7V		1.7		
V <sub>IL</sub>	Low-Level Input Voltage	Data Inputs	0.8V			0	
			1.1V to 1.95V			0.35 x V <sub>CCI</sub>	
			2.3V to 2.7V			0.7	
V <sub>IH</sub>	High-Level Input Voltage	Control Inputs (Referenced to V <sub>CCA</sub> )	0.8V		V <sub>CCA</sub>		
			1.1V to 1.95V		0.65 x V <sub>CCA</sub>		
			2.3V to 2.7V		1.7		
V <sub>IL</sub>	Low-Level Input Voltage	Control Inputs (Referenced to V <sub>CCA</sub> )	0.8V			0	
			1.1V to 1.95V			0.35 x V <sub>CCA</sub>	
			2.3V to 2.7V			0.7	
V <sub>I</sub>	Input Voltage				0	2.7V	
V <sub>O</sub>	Output Voltage	Active State			0	V <sub>CCO</sub>	
		3-State			0	2.7V	
I <sub>OH</sub>	High-Level output Current			0.8V		-0.7	
				1.1V		-3	
				1.4V		-5	
				1.65V		-8	
				2.3V		-9	
I <sub>OL</sub>	Low-Level output Current			0.8V		0.7	
				1.1V		3	
				1.4V		5	
				1.65V		8	
				2.3V		9	
Δt/Δv	Input transition rise or fall rate					5	ns/V
T <sub>A</sub>	Operating Free-Air Temperature				-40	85	°C

**Notes:**

1. All unused data inputs of the device must be held at V<sub>CCI</sub> or GND to ensure proper data device operation.
2. V<sub>CCI</sub> is the V<sub>CC</sub> (either V<sub>CCA</sub> or V<sub>CCB</sub>) associated with the data input port.
3. V<sub>CCO</sub> is the V<sub>CC</sub> (either V<sub>CCA</sub> or V<sub>CCB</sub>) associated with the data output port.

**Electrical Characteristics (A Port or B Port)** (Over recommended operating free-air temperature range )

Parameters		Test Conditions	V <sub>CCI</sub> <sup>(1)</sup>	V <sub>CCO</sub> <sup>(2)</sup>	Min.	Typ. <sup>(3)</sup>	Max.	Units
V <sub>OH</sub>		I <sub>OH</sub> = - 100μA    V <sub>I</sub> = V <sub>IH</sub>	0.8V - 2.7V	0.8V - 2.7V	V <sub>CCO</sub> - 0.1V			V
		I <sub>OH</sub> = - 0.7mA    V <sub>I</sub> = V <sub>IH</sub>	0.8V - 2.7V	0.8V		0.55		
		I <sub>OH</sub> = - 3mA    V <sub>I</sub> = V <sub>IH</sub>	0.8V - 2.7V	1.1V	0.8			
		I <sub>OH</sub> = - 5mA    V <sub>I</sub> = V <sub>IH</sub>	0.8V - 2.7V	1.4V	1.0			
		I <sub>OH</sub> = - 8mA    V <sub>I</sub> = V <sub>IH</sub>	0.8V - 2.7V	1.65V	1.2			
		I <sub>OH</sub> = - 9mA    V <sub>I</sub> = V <sub>IH</sub>	0.8V - 2.7V	2.3V	1.8			
V <sub>OL</sub>		I <sub>OH</sub> = 100μA    V <sub>I</sub> = V <sub>IL</sub>	0.8V - 2.7V	0.8V - 2.7V			0.2	V
		I <sub>OH</sub> = 0.7mA    V <sub>I</sub> = V <sub>IL</sub>	0.8V - 2.7V	0.8V		0.25		
		I <sub>OH</sub> = 3mA    V <sub>I</sub> = V <sub>IL</sub>	0.8V - 2.7V	1.1V			0.3	
		I <sub>OH</sub> = 5mA    V <sub>I</sub> = V <sub>IL</sub>	0.8V - 2.7V	1.4V			0.4	
		I <sub>OH</sub> = 8mA    V <sub>I</sub> = V <sub>IL</sub>	0.8V - 2.7V	1.65V			0.45	
		I <sub>OH</sub> = 9mA    V <sub>I</sub> = V <sub>IL</sub>	0.8V - 2.7V	2.3V			0.6	
I <sub>I</sub>	Control Inputs	V <sub>I</sub> = V <sub>CCA</sub> or GND, V <sub>CCA</sub> = 0 to 2.7V					±5	μA
I <sub>off</sub>		V <sub>I</sub> = 0 to 2.7V	0V	0V - 2.7V			±10	
		V <sub>O</sub> = 0 to 2.7V	0V - 2.7V	0V			±10	
I <sub>OZ</sub> <sup>(4)</sup>		V <sub>O</sub> = V <sub>CCO</sub> or GND $\overline{OE} = V_{IH}$	0.8V - 2.7V	0.8V - 2.7V			±10	
		$\overline{OE} = \text{Don't care}$	0.8V - 2.7V	0V			±10	
I <sub>CC</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0	0.8V - 2.7V	0.8V - 2.7V			20	
C <sub>I</sub>	Control Inputs	V <sub>I</sub> = 2.5V or GND	2.5V	2.5V		4		pF
C <sub>IO</sub>	I/O Ports	V <sub>O</sub> = 2.5V or GND	2.5V	2.5V		5		

**Notes:**

- V<sub>CCI</sub> is the V<sub>CC</sub> (either V<sub>CCA</sub> or V<sub>CCB</sub>) associated with the input port.
- V<sub>CCO</sub> is the V<sub>CC</sub> (either V<sub>CCA</sub> or V<sub>CCB</sub>) associated with the output port.
- All typical values are at T<sub>A</sub> = 25°C
- For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

**Switching Characteristics** (Over recommended operating free-air temperature range for V<sub>CCA</sub> = 0.8 V (See Figure 1))

Parameter	From (Input)	To (Output)	V <sub>CCB</sub> = 0.8V	V <sub>CCB</sub> = 1.2 ±0.1V	Units
			Typ.	Typ.	
t <sub>pd</sub>	A	B	8.5	5.0	ns
	B	A	8.5	7.5	
t <sub>en</sub>	$\overline{OE}$	A	8.0	8.0	
	$\overline{OE}$	B	9.0	5.0	
t <sub>dis</sub>	$\overline{OE}$	A	8.5	8.5	
	$\overline{OE}$	B	9.0	6.8	

**Switching Characteristics** (Over recommended operating free-air temperature range for  $V_{CCA} = 1.2V \pm 0.1V$  (See Figure 1))

Parameter	From (Input)	To (Output)	$V_{CCB} = 0.8V$	$V_{CCB} = 1.2 \pm 0.1V$		$V_{CCB} = 1.5 \pm 0.1V$		$V_{CCB} = 1.8 \pm 0.15V$			$V_{CCB} = 2.5 \pm 0.2V$		Units
			Typ.	Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
$t_{pd}$	A	B	8	1	4.5	0.5	3.5	0.5	2	3.5	0.5	3	ns
	B	A	5	1	4.5	0.5	4.0	0.5	3	4.0	0.5	3.5	
$t_{en}$	$\overline{OE}$	A	3.2	0.7	4.6	0.7	4.6	0.7	3.2	4.6	0.7	4.6	
	$\overline{OE}$	B	8	0.7	4.6	0.7	3.6	0.7	2.2	3.6	0.7	3.5	
$t_{dis}$	$\overline{OE}$	A	4.6	0.8	6.2	0.8	6.2	0.8	4.6	6.2	0.8	6.2	
	$\overline{OE}$	B	9	0.8	6.2	0.8	5	0.8	3.5	4.8	0.8	4.3	

**Switching Characteristics** (Over recommended operating free-air temperature range for  $V_{CCA} = 1.5V \pm 0.1V$  (See Figure 1))

Parameter	From (Input)	To (Output)	$V_{CCB} = 1.2 \pm 0.1V$		$V_{CCB} = 1.5 \pm 0.1V$		$V_{CCB} = 1.8 \pm 0.15V$			$V_{CCB} = 2.5 \pm 0.2V$		Units
			Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
$t_{pd}$	A	B	0.5	4.5	0.5	3.3	0.5	2.3	3.1	0.5	2.6	ns
	B	A	0.5	3.5	0.5	3.3	0.5	2	3	0.5	2.8	
$t_{en}$	$\overline{OE}$	A	0.7	3.3	0.7	3.1	0.7	2.3	3.3	0.7	3.3	
	$\overline{OE}$	B	0.7	4.3	0.7	3.1	0.7	2.3	3.3	0.7	3.2	
$t_{dis}$	$\overline{OE}$	A	0.8	4.5	0.8	4.7	0.8	3	4.5	0.8	4.5	
	$\overline{OE}$	B	0.8	5.5	0.8	4.7	0.8	3	4.5	0.8	3.7	

**Switching Characteristics** (Over recommended operating free-air temperature range for  $V_{CCA} = 1.8V \pm 0.15V$  (See Figure 1))

Parameter	From (Input)	To (Output)	$V_{CCB} = 1.2 \pm 0.1V$		$V_{CCB} = 1.5 \pm 0.1V$		$V_{CCB} = 1.8 \pm 0.15V$			$V_{CCB} = 2.5 \pm 0.2V$		Units
			Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
$t_{pd}$	A	B	0.5	4.2	0.5	3	0.5	2	2.8	0.5	2.5	ns
	B	A	0.5	3.5	0.5	3.1	0.5	2	2.8	0.5	2.6	
$t_{en}$	$\overline{OE}$	A	0.7	3	0.7	3	0.7	2.1	3	0.7	3	
	$\overline{OE}$	B	0.7	4	0.7	3	0.7	2.1	3	0.7	2.8	
$t_{dis}$	$\overline{OE}$	A	0.8	4.3	0.8	4.3	0.8	3.2	4.3	0.8	4.3	
	$\overline{OE}$	B	0.8	5.3	0.8	4.3	0.8	3.2	4.3	0.8	3	

**Switching Characteristics** (Over recommended operating free-air temperature range for  $V_{CCA} = 2.5V \pm 0.2V$  (See Figure 1)

Parameter	From (Input)	To (Output)	$V_{CCB} = 1.2 \pm 0.1V$		$V_{CCB} = 1.5 \pm 0.1V$		$V_{CCB} = 1.8 \pm 0.15V$			$V_{CCB} = 2.5 \pm 0.2V$		Units
			Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
$t_{pd}$	A	B	0.5	4	0.5	2.8	0.5	1.8	2.6	0.5	2.2	ns
	B	A	0.5	3	0.5	2.6	0.5	1.7	2.5	0.5	2.2	
$t_{en}$	$\overline{OE}$	A	0.7	2.6	0.7	2.6	0.7	1.8	2.6	0.7	2.6	
	$\overline{OE}$	B	0.7	4	0.7	2.8	0.7	2	3.1	0.7	2.6	
$t_{dis}$	$\overline{OE}$	A	0.8	2.9	0.8	2.9	0.8	2	2.9	0.8	2.9	
	$\overline{OE}$	B	0.8	5.3	0.8	4.1	0.8	3	4.3	0.8	2.9	

**Operating Characteristics** ( $V_{CCA}$  and  $V_{CCB} = 2.5V$ ,  $T_A = 25^\circ C$ )

Parameter		Test Conditions	Typ.	Units
$C_{pd}$ ( $V_{CCA}$ )	Power Dissipation Capacitance A to B	Outputs Enabled	3	pF
		Outputs Disabled	0.4	
	Power Dissipation Capacitance B to A	Outputs Enabled	14	
		Outputs Disabled	1.5	
$C_{pd}$ ( $V_{CCB}$ )	Power Dissipation Capacitance A to B	Outputs Enabled	14	
		Outputs Disabled	1.5	
	Power Dissipation Capacitance B to A	Outputs Enabled	3	
		Outputs Disabled	0.4	

### Parameter Measurement Information

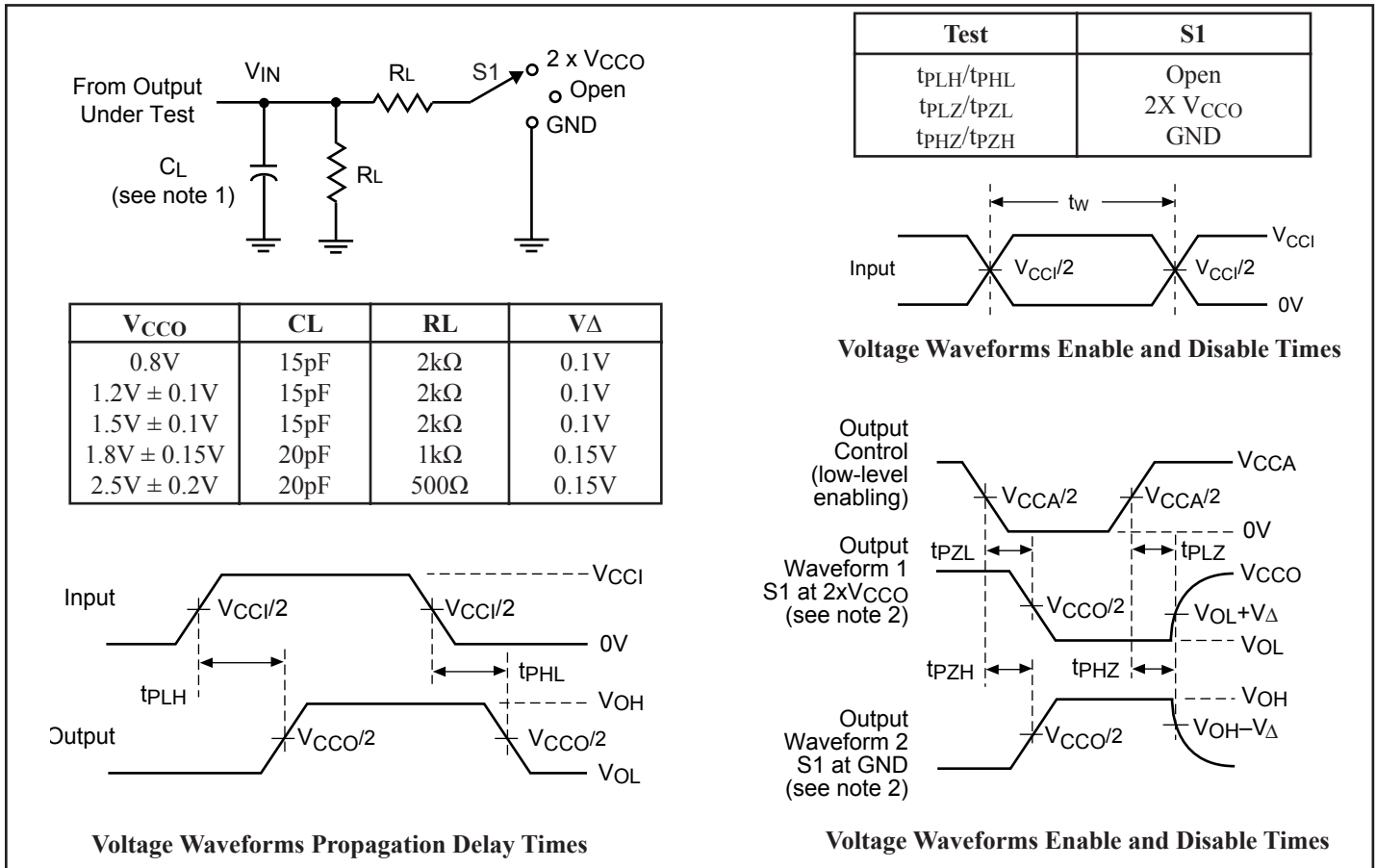
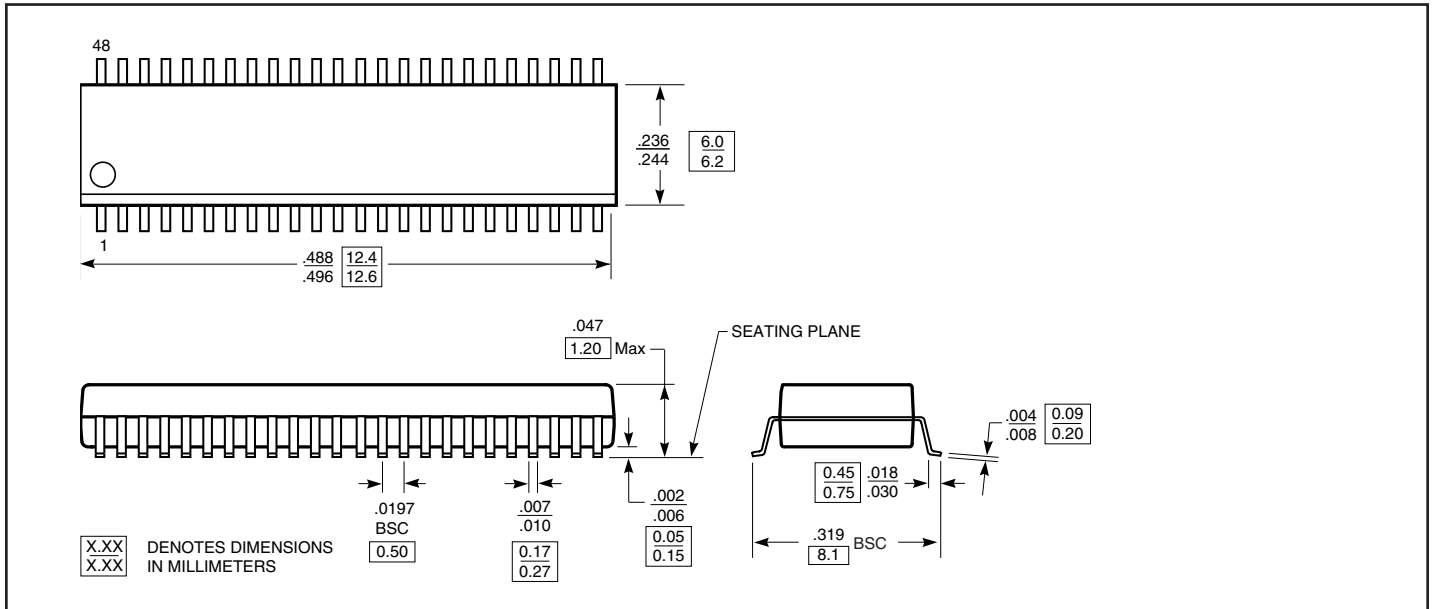


Figure 1. Load Circuit and Voltage Waveforms

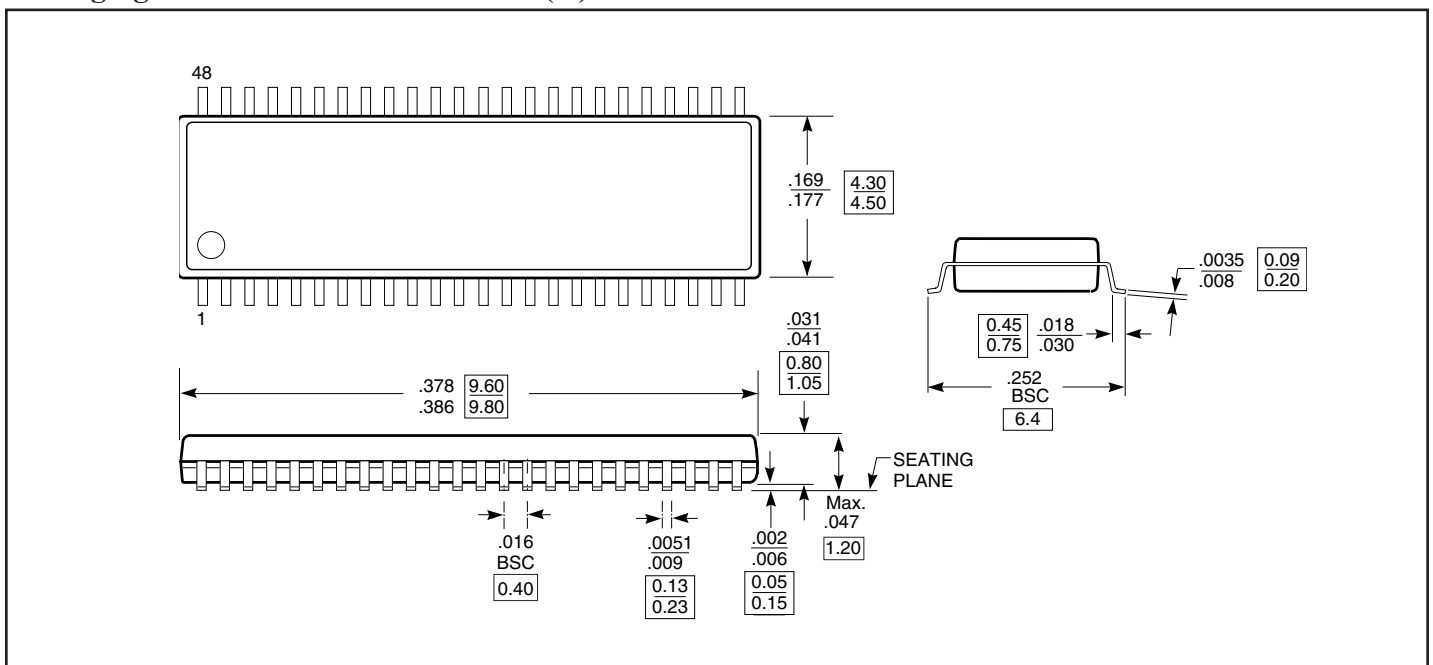
**Notes:**

- $C_L$  includes probe and jig capacitance.
  - 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.
- All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{Mz}$ ,  $Z_O = 50\Omega$ , Slow rate  $\geq 1\text{V/ns}$ .
  - The outputs are measured one at a time with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{DIS}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{EN}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{PD}$ .
  - $V_{CCI}$  defines the input port.
  - $V_{CCO}$  defines the output port.

**Packaging Mechanical: 48-Pin TSSOP (A)**



**Packaging Mechanical: 48-Pin TVSOP (K)**





**Ordering Information**

<b>Ordering Code</b>	<b>Package Code</b>	<b>Package Description</b>
PI74AUC164245A	A	48-pin, 240-mil wide plastic TSSOP
PI74AUC164245AE	A	Pb-free & Green, 48-pin, 240-mil wide plastic TSSOP
PI74AUC164245K	K	48-pin, 173-mil wide plastic TVSOP
PI74AUC164245KE	K	Pb-free & Green, 48-pin, 173-mil wide plastic TVSOP

**Notes:**

- Thermal characteristics can be found on the company web site at [www.pericom.com/packaging/](http://www.pericom.com/packaging/)
- E = Pb-free & Green
- Adding an X suffix = Tape/Reel