16-Bit 1.5-2.5V to 3.3V Level Shifting Transceiver with 3-State Outputs

Features

- PI74AVC164245LA is designed for low voltage operation: 1.5V - 2.5V to 3.3V
- Industrial operation at –40°C to +85°C
- Packag (Pb-free & Green available):
  – 48-pin plastic 240-mil TSSOP (A)
  – 48-pin plastic 173-mil TVSOP (K)

Description

Pericom Semiconductor's PI74AVC164245LA, a 16-bit (dual-octal) noninverting bus transceiver, contains two separate supply rails: B port (V_{CCB}), set at 3.3V, and A port (V_{CCA}), set to operate at 1.5-2.5V. This arrangement permits translation from a 1.5-2.5V to 3.3V environment and vice versa. The control pins, $\overline{OE}$ and DIR are controlled by V_{CCB} .

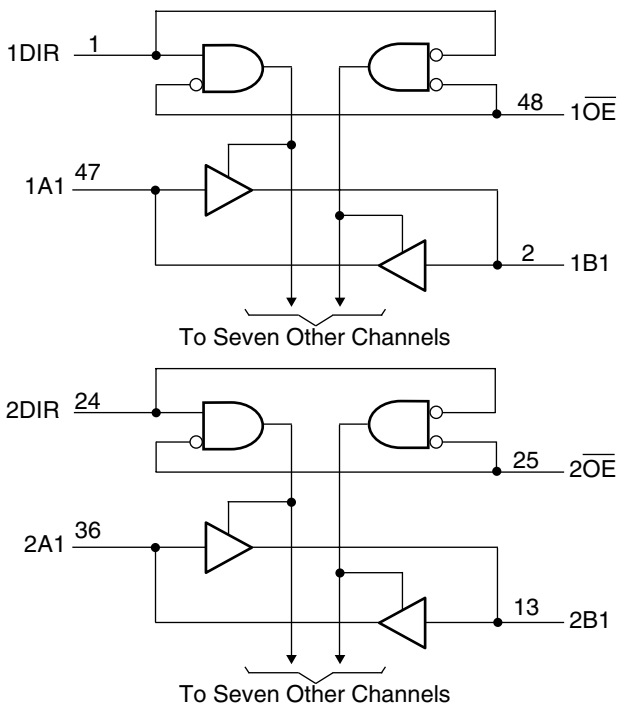
The PI74AVC164245LA is designed for asynchronous communication between data buses.

To ensure the high impedance state during power up or power down, the output-enable ($\overline{OE}$) 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.

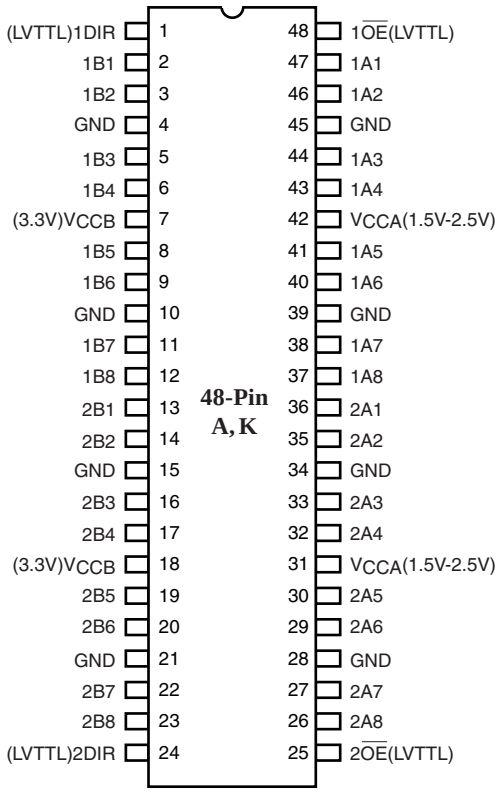
Truth Table (each 8-bit section)

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

Block Diagram



Pin Configuration



Maximum Ratings

(Absolute maximum ratings over operating free-air temperature range from V_{CCB} at 3.3V & V_{CCA} at 1.5 - 2.5V, unless otherwise noted)

Supply voltage range: V_{CCA} ..... –0.5V to 3.8V
V_{CCB} ..... –0.5V to 4.6V

Input Voltage Range, V_I Except I/O ports(1) ..... –0.5V to 4.6V
I/O port A(2) ... –0.5V to V_{CCA}+0.5V
I/O port B(1) .... –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 ..... ±50mA

Continuous current through each V_{CC} or GND ..... ±100mA

Package thermal impedance, 0_{JA}(3): A package ..... 89°C/W
K package ..... 58°C/W
V package ..... 94°C/W

Storage temperature range, T_{STG} ..... –65°C to 150°C

Note:
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.

Recommended Operating Conditions for V_{CCB} at 3.3V(4)

		Min.	Max.	Units
V_{CCB}(1)	Supply voltage	3.0	3.6	V
V_{IH}	High-level voltage	2		
V_{IL}	Low-level voltage		0.8	
V_{IA}	Input Voltage	0	V_{CCB}	
V_{OB}	Output Voltage	0	V_{CCB}	
I_{OH}	High-level output current		–12	mA
I_{OL}	Low-level output current		12	
$\Delta t/\Delta v$	Input transition rise or fall rate		10	ns/V
T_A	Operating free-air temperature	–40	85	°C

Recommended Operating Conditions for V_{CCA} at 2.5V(4)

			Min.	Max.	Units
V_{CCA}(2)	Supply voltage		2.3	2.7	V
V_{IH}	High-level voltage	V_{CCA} = 2.3V to 2.7V	1.7		
V_{IL}	Low-level voltage	V_{CCA} = 2.3V to 2.7V		0.7	
V_{IB}	Input voltage		0	V_{CCA}	
V_{OA}	Output voltage		0	V_{CCA}	
I_{OH}	High-level output current	V_{CCA} = 2.3V		–8	mA
		V_{CCA} = 2.7V		–12	
I_{OL}	Low-level output current	V_{CCA} = 2.3V		8	
		V_{CCA} = 2.7V		12	
$\Delta t/\Delta v$	Input transition rise or fall rate			10	ns/V
T_A	Operating free-air temperature		–40	85	°C

Notes:
1. This value is limited to 4.6V maximum.
2. This value is limited to 3.8V maximum.
3. The package thermal impedance is calculated in accordance with JESD 51.
4. To ensure proper device operation, all unused device inputs must be held at the associated V_{CC} or GND.

Recommended Operating Conditions for V_{CCA} at 1.5V(2)

			Min.	Max.	Units
V_{CCA}(1)	Supply voltage		1.4	1.6	V
V_{IH}	High-level voltage	V_{CCA} = 1.4V to 1.6V	0.65 x V_{CCA}		
V_{IL}	Low-level voltage	V_{CCA} = 1.4V to 1.6V		0.35 x V_{CCA}	
V_{IB}	Input voltage		0	V_{CCA}	
V_{OA}	Output voltage		0	V_{CCA}	
I_{OH}	High-level output current	V_{CCA} = 1.4V		–2	mA
		V_{CCA} = 1.6V		–6	
I_{OL}	Low-level output current	V_{CCA} = 1.4V		2	
		V_{CCA} = 1.6V		6	
$\Delta t/\Delta v$	Input transition rise or fall rate			10	ns/V
T_A	Operating free-air temperature		–40	85	°C

Electrical Characteristics (V_{CCB}) (Over recommended operating free-air temperature range for V_{CCB} = 3.3V)

Parameters		Test Conditions	V_{CCB}	Min.	Typ(3)	Max.	Units
V_{OH} (A to B)		I_{OH} = –100µA	3.0V	2.8			V
			3.6V	3.4			
		I_{OH} = –12mA	3.0V	2.2			
			3.6V	2.8			
V_{OL} (A to B)		I_{OL} = 100µA	3.0V			0.2	
			3.6V			0.2	
		I_{OL} = 12mA	3.0V			0.5	
			3.6V			0.5	
I_I	Control Inputs	V_I = V_{CCB} or GND	3.6V			±5	µA
I_{OZ}(4)	A or B ports	V_O = V_{CCB} or GND	3.6V			±10	
I_{CC}		V_I = V_{CCB} or GND, I_O = 0	3.6V			20	
ΔI_{CC} (5)		One input at V_{CCB} –0.6V, Other inputs at V_{CCB} or GND	3.0V to 3.6V			500	
C_I	Control Inputs	V_I = V_{CCB} or GND	3.3V		4.5		pF
C_{IO}	A or B ports	V_O = V_{CCB} or GND	3.3V		6.5		

Notes:
1. Value limited to 4.6V maximum..
2.To ensure proper device operation, all unused device inputs must be held at the associated V_{CC} or GND.
3. Typical values are measured at V_{CC} = 3.3V, T_A = 25°C
4. For I/O ports, the parameter I_{OZ} includes the input leakage current.
5. This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than at 0 or the associated V_{CC}.

Electrical Characteristics (V_{CCA}) (Over recommended operating free-air temperature range for V_{CCA} = 2.5V)

Parameters		Test Conditions	V_{CCA}	Min.	Typ.(2)	Max.	Units
V_{OH} (B to A)		I_{OH} = –100µA	2.3V to 2.7V	V_{CC}-0.1			V
		I_{OH} = –8mA	2.3V	1.7			
			2.7V	2.0			
		I_{OH} = –12mA	2.7V	1.8			
V_{OL} (B to A)		I_{OL} = 100µA	2.3V to 2.7V			0.2	
		I_{OL} = 8mA	2.3V			0.4	
		I_{OL} = 12mA	2.7V			0.5	
I_I	Control Inputs	V_I = V_{CCA} or GND	2.7V			±5	µA
I_{OZ}(3)	A or B ports	V_O = V_{CCA} or GND	2.7V			±10	
I_{CC}		V_I = V_{CCA} or GND, I_O = 0	2.7V			30	
ΔI_{CC}(1)		One input at V_{CCA} –0.6V, Other inputs at V_{CCA} or GND	2.3V to 2.7V			500	
C_I	Control Inputs	V_I = V_{CCA} or GND	2.5V		4.5		pF
C_{IO}	A or B ports	V_O = V_{CCA} or GND	2.5V		6.5		

Electrical Characteristics (V_{CCA}) (Over recommended operating free-air temperature range for V_{CCA} = 1.5V)

Parameters		Test Conditions	V_{CCA}	Min.	Typ.(2)	Max.	Units
V_{OH} (B to A)		I_{OH} = –100µA	1.4V to 1.6V	V_{CC} –0.1			V
		I_{OH} = –2mA	1.4V	1.1			
			1.6V	1.3			
		I_{OH} = –6mA	1.6V	1.1			
V_{OL} (B to A)		I_{OL} = 100µA	1.4V			0.2	
		I_{OL} = 2mA	1.6V			0.3	
		I_{OL} = 6mA	1.6V			0.4	
I_{OZ}(3)	A or B ports	V_O = V_{CCA} or GND	1.6V			±5	µA
I_{CC}		V_I = V_{CCA} or GND, I_O = 0	1.6V			±20	
ΔI_{CC}(1)		One input at V_{CCA} –0.6V, Other inputs at V_{CCA} or GND	1.4V to 1.6V			300	
C_I	Control Inputs	V_I = V_{CCA} or GND	1.5V		4.5		pF
C_{IO}	A or B ports	V_O = V_{CCA} or GND	1.5V		6.5		

Notes:
1. The increase in supply current for each input at one of the specified TTL voltage levels rather than at the associated V_{CC}.
2. Typical values are measured at V_{CC} = 2.5V or 1.5V, T_A = 25°C
3. For I/O ports, the parameter I_{OZ} includes the input leakage current.

Switching Characteristics

(Over recommended operating free-air temperature range, C_L = 30pF (unless otherwise noted), see Figures 1, 2, 3

Parameter	From (Input)	To (Output)	PI74AVC164245LA				Units
			V_{CCB} = 3.3V ±0.3V				
			V_{CCA} = 1.5V ±0.10V		V_{CCA} = 2.5V ±0.2V		
			Min.	Max.	Min.	Max.	
t_{PD}	A	B	1.0	3.5	1.0	3.0	ns
	B	A	1.0	3.5	1.0	2.8	
t_{EN}	$\overline{OE}$	B	1.7	4.5	1.2	3.5	
t_{DIS}	$\overline{OE}$	B	1.5	4.5	1.0	3.5	
t_{EN}	$\overline{OE}$	A	1.7	4.5	1.2	3.5	
t_{DIS}	$\overline{OE}$	A	2.0	4.5	1.5	3.5	
$t_{sk(o)}$(1)						0.3	
$t_{sk(b)}$(1)						0.25	

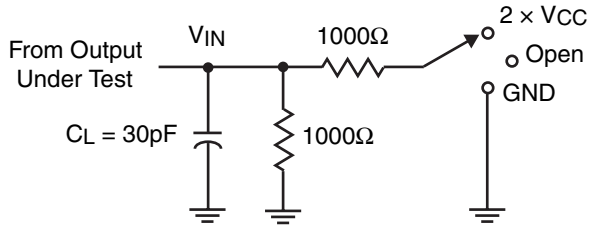
Note:

1. This is the skew between any two outputs of the same package, and switching in the same direction. For $tsk_{(o)}$, Output 1 and Output 2 are any two outputs. For $tsk_{(b)}$, Output 1 and Output 2 are in the same bank.
   These parameters are warrented but not production tested.

Operating Characteristics, T_A = 25°C

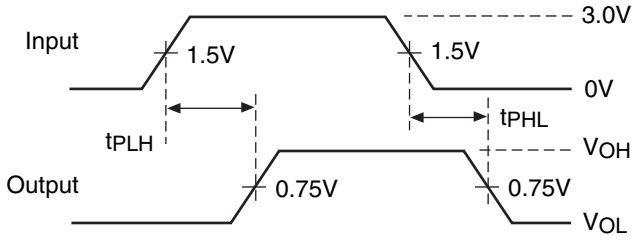
Parameters		Test Conditions	V_{CCA} = 2.5V, V_{CCB} = 3.3V	Units
			Typical	
C_{PD} Power Dissipation Capacitance	Outputs Enabled (A or B)	C_L = 30pF, F = 10 MHz	56	pF
			6	

Parameter Measurement Information, V_{CCA} = 1.5V ±0.10V

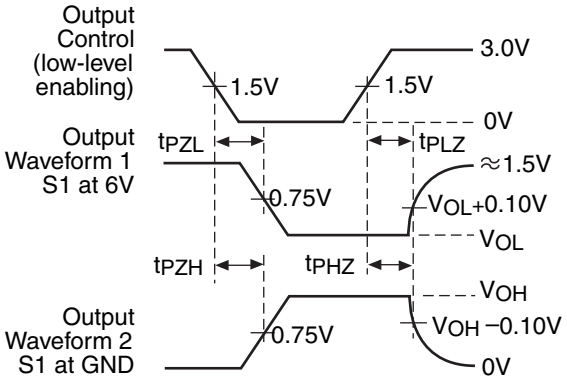


Test	S1
t_{PD}	Open
t_{PLZ}/t_{PZL}	2 × V_{CC}
t_{PHZ}/t_{PZH}	GND

Load Circuit



Voltage Waveforms
Propagation Delay Times



Voltage Waveforms
Enable and Disable Times

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 ≤10Mz, Z_O = 50Ω, $t_R \leq$ 2.5ns, $t_F \leq$ 2.5ns.
- 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}.

Parameter Measurement Information, V_{CCA} = 2.5V ± 0.2V

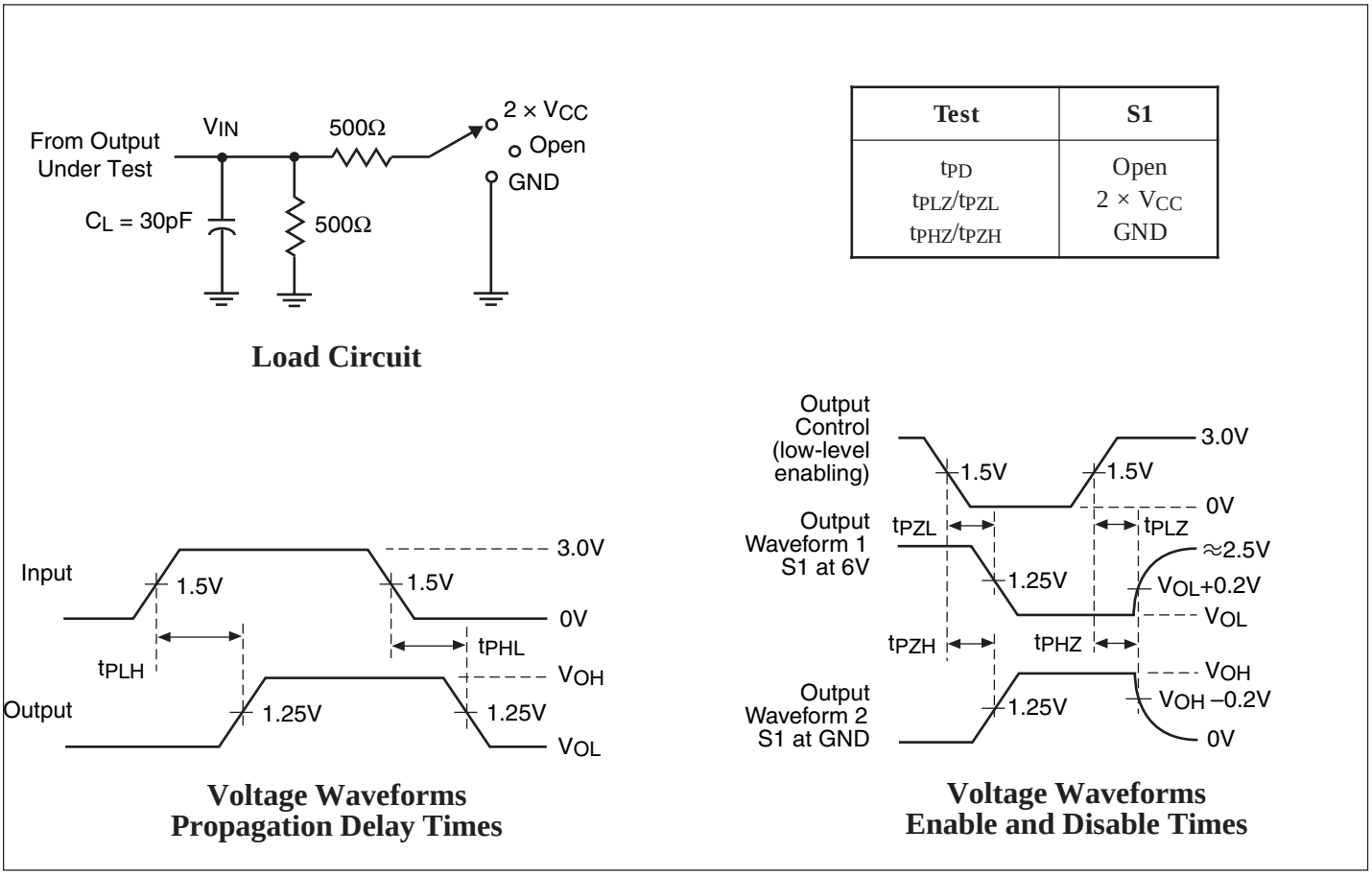
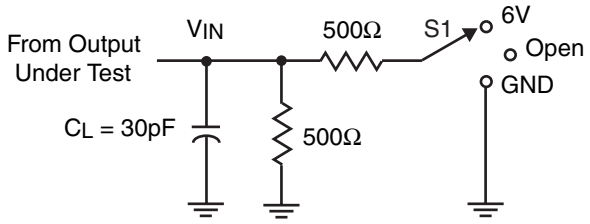


Figure 2. Load Circuit and Voltage Waveforms

Notes:

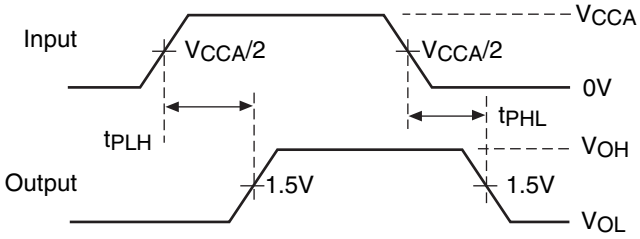
- C_L includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: PRR ≤10Mz, Z_O = 50Ω, t_R ≤2.5ns, t_F ≤2.5ns.
- 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}.

Parameter Measurement Information, V_{CCB} = 3.3V ±0.3V

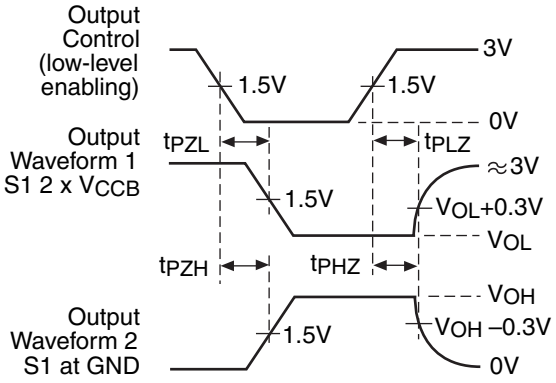


Test	S1
t_{PD}	Open
t_{PLZ}/t_{PZL}	6V
t_{PHZ}/t_{PZH}	GND

Load Circuit



Voltage Waveforms
Propagation Delay Times

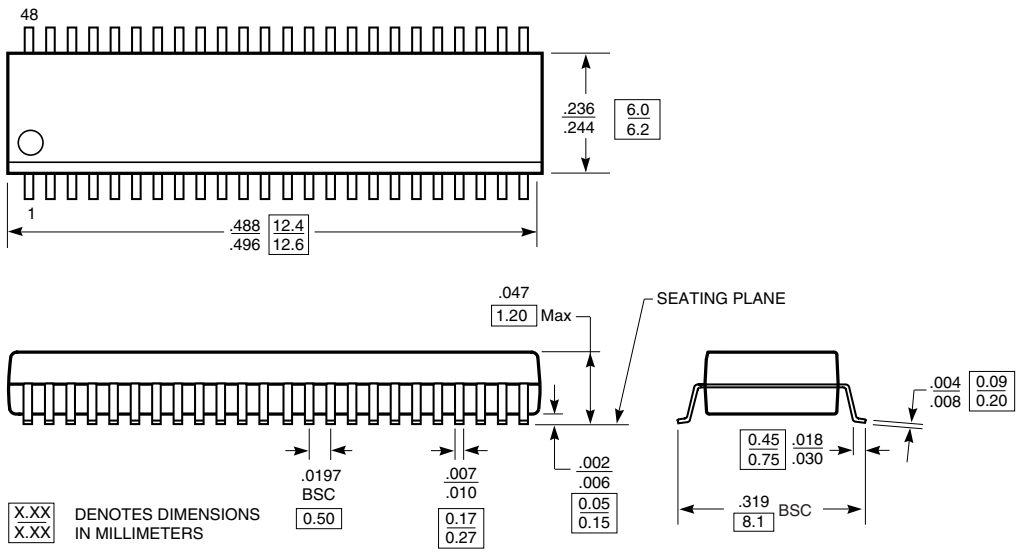


Voltage Waveforms
Enable and Disable Times

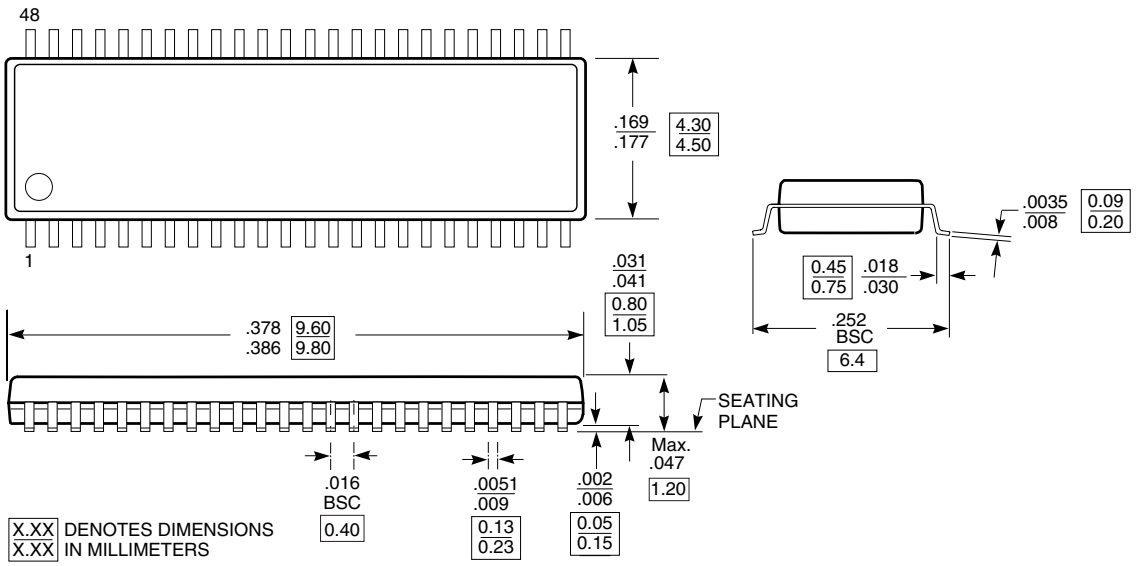
Figure 3. Load Circuit and Voltage Waveforms

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 ≤10Mz, Z_O = 50Ω, t_R ≤2.5ns, t_F ≤2.5ns.
- 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}.

Packaging Mechanical: 48-Pin TSSOP (A)



Packaging Mechanical: 48-Pin TVSOP (K)



Ordering Information

Ordering Code	Package Code	Speed Grade	Package Description
PI74AVC164245LAA	A	A	48-pin, 240-mil wide plastic TSSOP
PI74AVC164245LAAE	A	A	Pb-free & Green, 48-pin, 240-mil wide plastic TSSOP
PI74AVC164245LAK	K	A	48-pin, 173-mil wide plastic TVSOP
PI74AVC164245LAKE	K	A	Pb-free & Green, 48-pin, 173-mil wide plastic TVSOP

Notes:
1. Thermal characteristics can be found on the company web site at www.pericom.com/packaging/