PERICOM®

PI74AVC164245

16-Bit 1.2-2.5V to 3.3V Level Shifting Transceiver with 3-State Outputs

Features

→ PI74AVC164245 is designed for low voltage operation:
   1.2V - 2.5V to 3.3V

→ Industrial operation at –40°C to +85°C

→ Packaging (Pb-free & Green):
   – 48-pin plastic 300-mil SSOP (V)
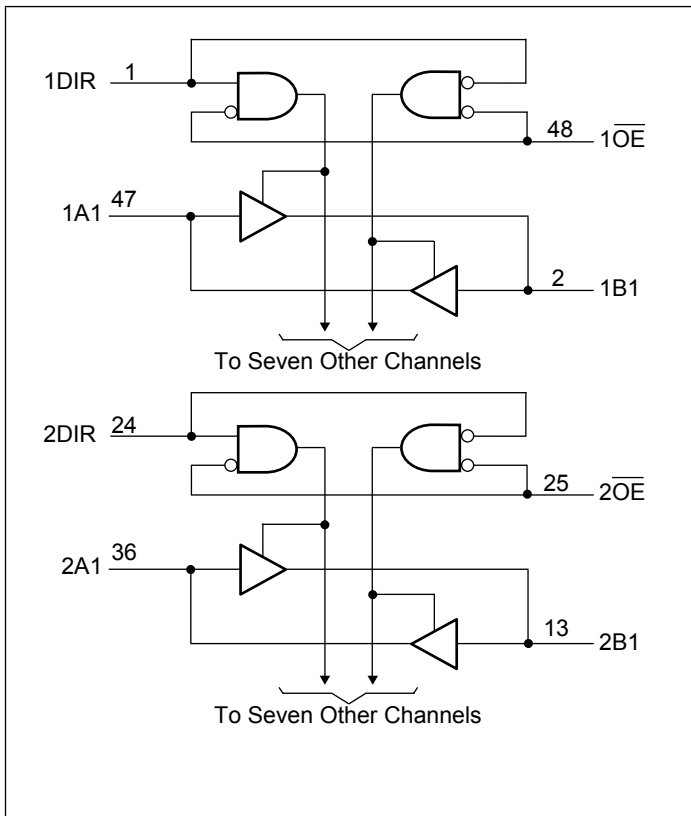   – 48-pin plastic 240-mil TSSOP (A)
   – 48-pin plastic 173-mil TVSOP (K)

Description

Pericom Semiconductor's PI74AVC164245, 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 1.2-2.5V. This arrangement permits translation from a 1.2-2.5V to 3.3V environment and vice versa.
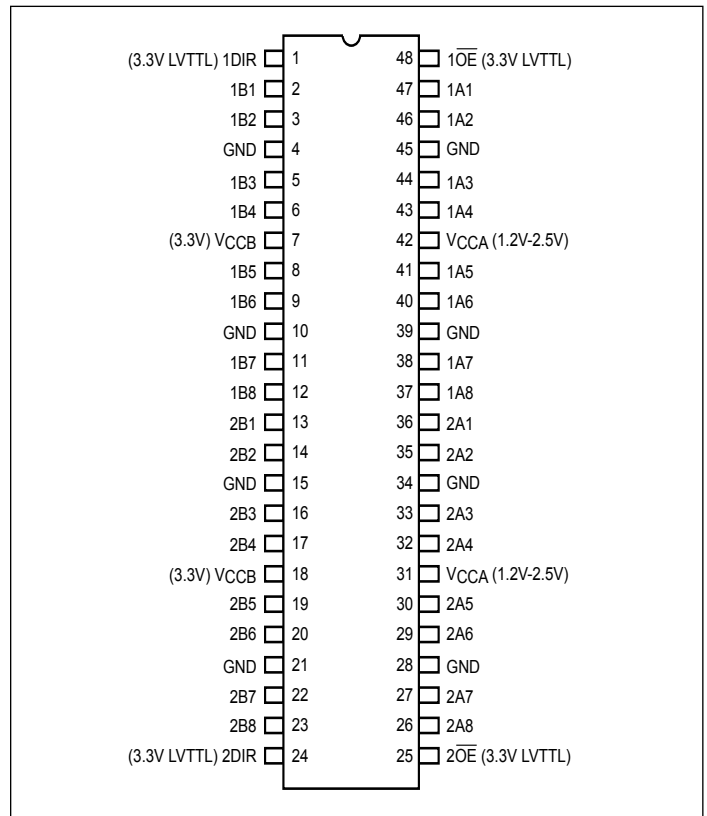
The PI74AVC164245 is designed for asynchronous communication between data buses.

To ensure the high impedance state during power up or power down, the output-enable ($\overline{OE}$) input should be tied to V_{CCB} 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 (28-Pin TQFN)

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

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.

Supply Voltage Range V_{CCA}.......................−0.5V to 3.8V	Continuous output current, I_O.........................±50mA
V_{CCB}.......................−0.5V to 4.6V	Continuous current through each V_{CC} or GND ....±100mA
	Package thermal impedance, $0_{JA}^{(3)}$: A package.............89°C/W
Input Voltage Range, V_I Except I/O ports[1] .−0.5V to 4.6V	K package ....58°C/W
I/O port A[2] ..−0.5V to V_{CCA}+0.5V	V package ....94°C/W
I/O port B[1] ..−0.5V to V_{CCB}+0.5V	Storage temperature range, T_{STG}.....................−65°C to 150°C
Input Clamp Current $I_{IK}(V_1<0)$ ....−50mA	
Ouput Clamp Current $I_{OK}(V_O<0)$.............................−50mA	

Recommended Operating Conditions for V_{CCB} at 3.3V[4]

		Min.	Max.	Units
V_{CCB}	Supply voltage	3.0	3.6	V
V_{IH}	High-level voltage	2		
V_{IL}	Low-level voltage		0.8	
V_{IB}	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$_{CCA}$	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$_{IA}$	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	
Δt/Δv	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 1.8V[4]

			Min.	Max.	Units
V$_{CCA}$	Supply voltage		1.65	1.95	V
V$_{IH}$	High-level voltage	V$_{CCA}$ = 1.65V to 1.95V	0.65 x V$_{CCA}$		
V$_{IL}$	Low-level voltage	V$_{CCA}$ = 1.65V to 1.95V		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$_{CCA}$ = 1.65V		-4	mA
		V$_{CCA}$ = 1.95V		−8	
I$_{OL}$	Low-level output current	V$_{CCA}$ = 1.65V		4	
		V$_{CCA}$ = 1.95V		8	
Δt/Δv	Input transition rise or fall rate			10	ns/V
T$_{A}$	Operating free-air temperature		−40	85	°C

Notes:

1. To ensure proper device operation, all unused device inputs must be held at the associated VCC or GND.

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

Parameter		Test Conditions	V_{CCB}	Min.	Typ.†	Max.	Units
V_{OH} (A to B)		$I_{OH} = -100\mu A$	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)		$I_{OL} = -100\mu A$	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}‡	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}*		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:

† Typical values are measured at V_{CCB} = 3.3V, T_A = 25°C

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

* 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)

Parameter		Test Conditions	V_{CCA}	Min.	Typ.†	Max.	Units
V_{OH} (B to A)		$I_{OH} = -100\mu A$	2.3V to 2.7V	V_{CC} - 0.1			V
			2.3V	1.7			
		$I_{OH} = -8mA$	2.3V	2.0			
		$I_{OH} = -12mA$	2.7V	1.8			
V_{OL} (B to A)		$I_{OL} = -100\mu A$	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}‡	A or B ports	$V_O = V_{CCB}$ or GND	2.7V			±10	
I_{CC}		$V_I = V_{CCA}$ or GND, $I_O = 0$	2.7V			30	
ΔI_{CC}*		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		

Notes:

† Typical values are measured at V_{CCA} = 2.5V, T_A = 25°C

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

* 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} = 1.8V)

Parameter		Test Conditions	V_{CCA}	Min.	Typ.**	Max.	Units
V_{OH} (B to A)		$I_{OH} = -100\mu A$	1.65V to 1.95V	V_{CC} - 0.1			V
		$I_{OH} = -4mA$	1.65V	1.3			
			1.95V	1.4			
		$I_{OH} = -8mA$	1.95V	1.3			
V_{OL} (B to A)		$I_{OL} = 100\mu A$	1.65V			0.2	
		$I_{OL} = 4mA$	1.95V			0.3	
		$I_{OL} = 8mA$	1.95V			0.4	
I_{OZ}***	A or B ports	$V_O = V_{CCA}$ or GND	1.95V			±5	μA
I_{CC}		$V_I = V_{CCA}$ or GND, $I_O = 0$	1.95V			±20	
ΔI_{CC}*		One input at V_{CCA} – 6V, Other inputs at V_{CCA} or GND	1.65V to 1.95V			300	
C_I	Control Inputs	$V_I = V_{CCA}$ or GND	1.8V		4.5		pF
C_{IO}	A or B ports	$V_O = V_{CCA}$ or GND	1.8V		6.5		

Notes:

* The increase in supply current for each input at one of the specified TTL voltage levels rather than at the associated V_{CC}.

** Typical values are measured at V_{CCA} = 1.8V, T_A = 25°C

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

Recommended Operating Conditions for V_{CCA} at 1.2V

			Min.	Typ.	Max.	Units
V_{CCA}	Supply voltage			1.2V		V
V_{IH}	High-level voltage	$V_{CCA} = 1.2V$	$0.65 \times V_{CCA}$			
V_{IL}	Low-level voltage	$V_{CCA} = 1.2V$			$0.35 \times V_{CCA}$	
V_{IB}	Input Voltage		0		V_{CCA}	
V_{OA}	Output Voltage		0		V_{CCA}	
I_{OH}	High-level output current	$V_{CCA} = 1.2V$		-2		mA
I_{OL}	Low-level output current	$V_{CCA} = 1.2V$		2		
$\Delta t/\Delta v$	Input transition rise or fall rate				10	ns/V
T_A	Operating free-air temperature		−40		85	°C

Notes:
1. To ensure proper device operation, all unused device inputs must be held at the associated V_{CC} or GND.

Electrical Characteristics (V_{CCA}) (Over recommended operating free-air temperature range for $V_{CCA} = 1.2V$)

Parameter		Test Conditions	V_{CCA}	Min.	Typ.	Max.	Units
V_{OH} (B to A)		$I_{OH} = -2mA$	1.2V		1.1V		
V_{OL} (B to A)		$I_{OL} = 100\mu A$	1.2V		0.1		
		$I_{OL} = 2mA$	1.2V		0.1		
I_{OZ}**	A or B ports	$V_O = V_{CCA}$ or GND	1.2V		±5		µA
I_{CC}		$V_I = V_{CCA}$ or GND, $I_O = 0$	1.2V		10		
C_I	Control Inputs	$V_I = V_{CCA}$ or GND	1.2V		4.5		pF
C_{IO}	A or B ports	$V_O = V_{CCA}$ or GND	1.2V		6.5		

Notes:

*   The increase in supply current for each input at one of the specified TTL voltage levels rather than at the associated V_{CC}.

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

Switching Characteristics (C$_L$ = see Figures 1,2,3,4)

| Parameter | From (Input) | To (Output) | PI74AVC164245 V$_{CCB}$ = 3.3V ±0.3V | | | | PI74AVC164245A V$_{CCB}$ = 3.3V ±0.3V | | | | | Units |
| | | | V$_{CCA}$ = 1.8V ±0.15V | | V$_{CCA}$ = 2.5V ±0.2V | | V$_{CCA}$ = 1.2V | V$_{CCA}$ = 1.8V ±0.15V | | V$_{CCA}$ = 2.5V ±0.2V | | |
			Min.	Max.	Min.	Max.	Typ.	Min.	Max.	Min.	Max.	
t$_{PD}$	A	B	1.5	4.6	1.5	4.2	3.5	1.5	3.5	1.0	3.0	
	B	A	1.5	4.4	1.5	4.0	3.0	1.5	3.5	1.0	2.8	
t$_{EN}$	$\overline{OE}$	B	1.7	5.5	1.7	4.5	2.8	1.7	4.5	1.2	3.5	
t$_{DIS}$	$\overline{OE}$	B	1.5	5.5	1.5	4.5	2.2	1.5	4.5	1.0	3.5	ns
t$_{EN}$	$\overline{OE}$	A	1.7	5.5	1.7	4.5	4.2	1.7	4.5	1.2	3.5	
t$_{DIS}$	$\overline{OE}$	A	2.0	5.5	2.0	4.5	3.3	2.0	4.5	1.5	3.5	
t$_{SK(O)}$[1]						0.5					0.3	
t$_{SK(b)}$[1]						0.3					0.25	

Notes:

1. This is the skew between any two outputs of the same package, and switching in the same direction. For t$_{SK(O)}$, Output 1 and Output 2 are any two outputs. For t$_{SK(b)}$, Output 1 and Output 2 are on the same bank.

Operating Conditions for T$_A$ = 25 °C

Parameters		Test Conditions	V$_{CCA}$ = 2.5V V$_{CCB}$ = 3.3V Typical	Units
C$_{PD}$ Power Dissipation Capacitance	Outputs Enabled (A or B)	C$_L$ = 30pF	56	pF
	Outputs Disabled	F = 10MHz	6	

Parameter Measurement Information, V_{CCO} = 1.2V

Test	S1
t_{PD} t_{PLZ}/ t_{PZL} t_{PHZ}/ t_{PZH}	Open 2 x V_{CCO} GND

Voltage Waveforms
Enable and Disable Times
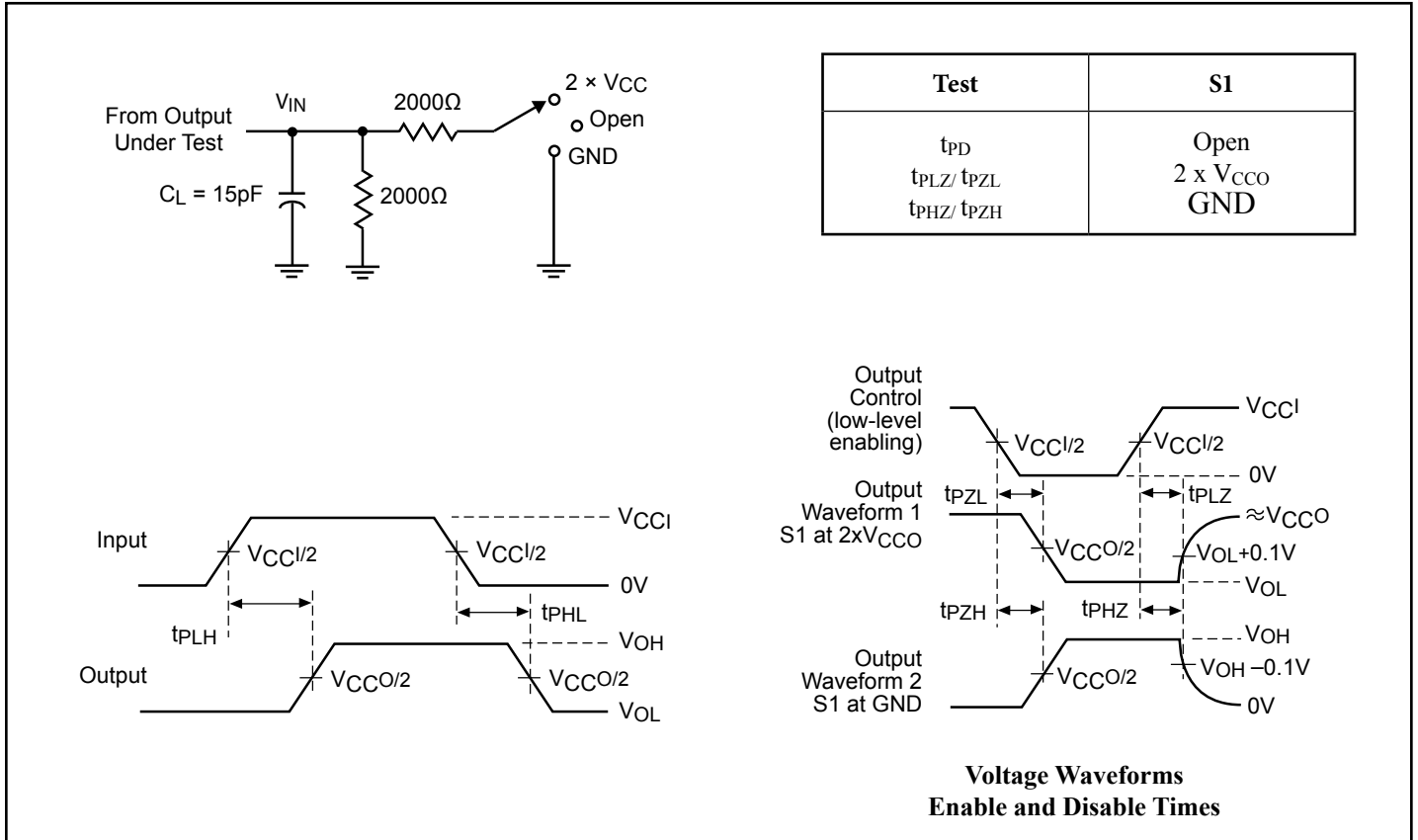
Figure 1. Load Circuit and Voltage Waveforms

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 ≤ **2.5**ns, 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_{CCO} = 1.8V ± 0.15V

From Output Under Test

V_{IN}

1000Ω

2 × V_{CC}
Open
GND

C_L = 30pF

1000Ω

Test	S1
t_{PD}	Open
t_{PLZ}/ t_{PZL}	2 x V_{CCO}
t_{PHZ}/ t_{PZH}	GND

Input

$V_{CCI}/2$ $V_{CCI}/2$

V_{CCI}

0V

t_{PLH}

t_{PHL}

V_{OH}

Output

$V_{CCO}/2$ $V_{CCO}/2$

V_{OL}

Output Control (low-level enabling)

$V_{CCI}/2$ $V_{CCI}/2$

V_{CCI}

0V

Output Waveform 1 S1 at 2xV_{CCO}

t_{PZL} t_{PLZ}

$V_{CCO}/2$ ≈V_{CCO} V_{OL}+0.15V V_{OL}

t_{PZH} t_{PHZ}

V_{OH} V_{OH} −0.15V

Output Waveform 2 S1 at GND

$V_{CCO}/2$

0V

**Voltage Waveforms
Enable and Disable Times**

Figure 2. Load Circuit and Voltage Waveforms

Notes:

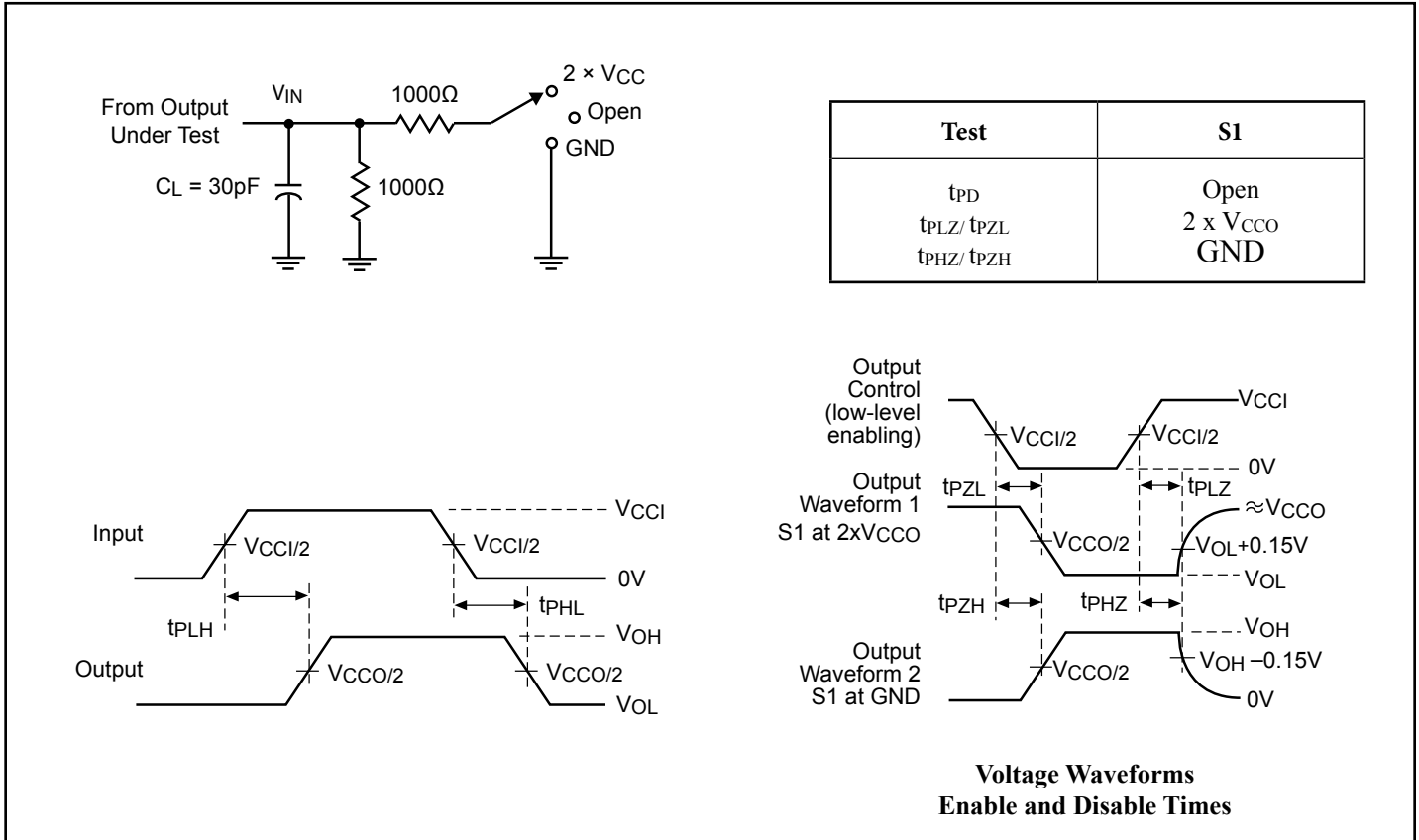C_L includes probe and jig capacitance.

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 ≤ **2.5**ns, 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$_{CCO}$ = 2.5V ± 0.2V

Test	S1
t$_{PD}$ t$_{PLZ}$/ t$_{PZL}$ t$_{PHZ}$/ t$_{PZH}$	Open 2 x V$_{CCO}$ GND

Voltage Waveforms
Enable and Disable Times

Figure 3. Load Circuit and Voltage Waveforms

Notes:

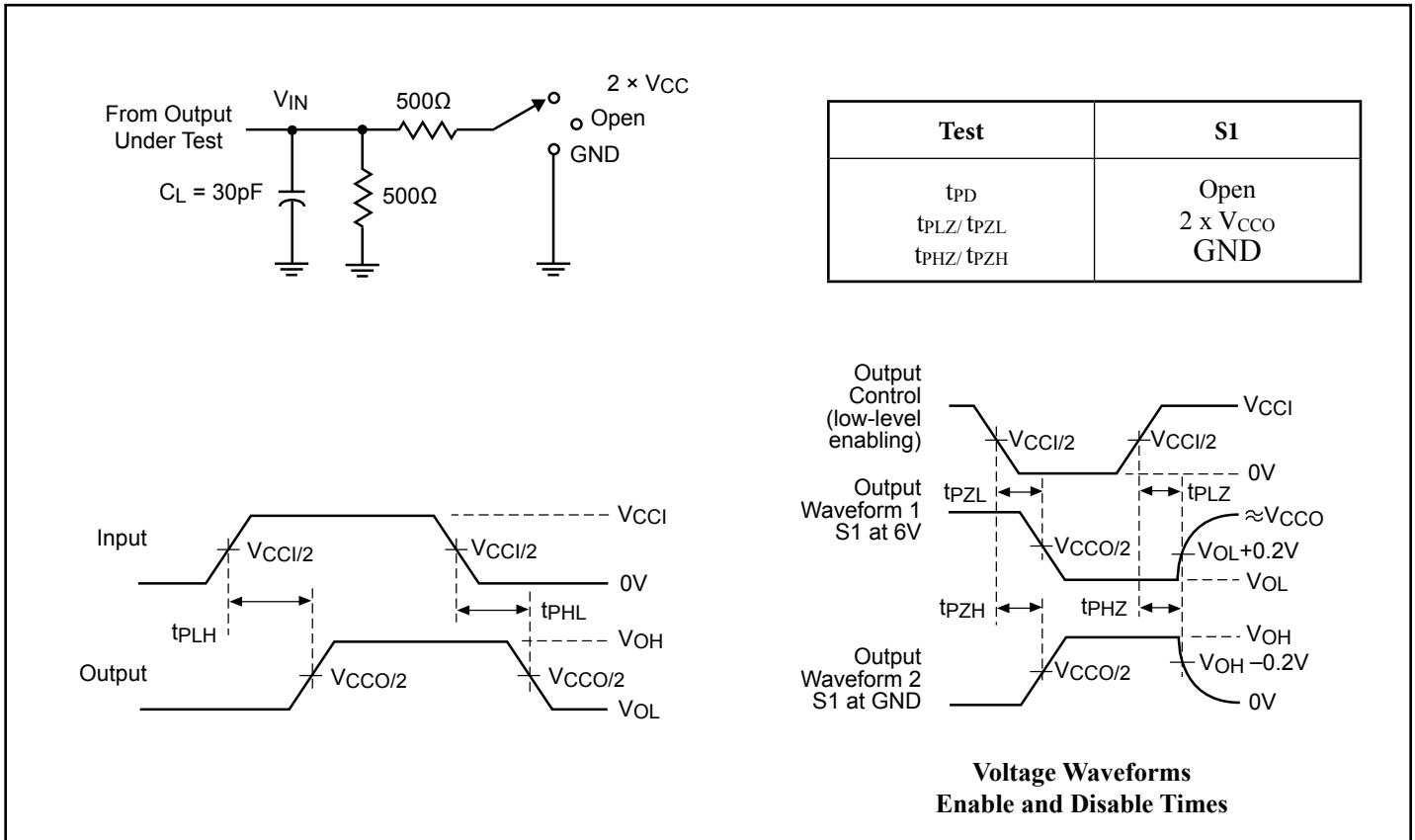C$_L$ includes probe and jig capacitance.

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$_R$ ≤ **2.5**ns, 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_{CCO} = 3.3V ± 0.3V

From Output Under Test

V_{IN} 500Ω   S1   6V / Open / GND

C_L = 30pF   500Ω

Test	S1
t_{PD} t_{PLZ}/ t_{PZL} t_{PHZ}/ t_{PZH}	Open 2 x V_{CCO} GND

Input — $V_{CCI}/2$ … $V_{CCI}/2$ — V_{CCA} / 0V
t_{PLH} … t_{PHL}
Output — $V_{CCO}/2$ … $V_{CCO}/2$ — V_{OH} / V_{OL}

Output Control (low-level enabling) — $V_{CCI}/2$ … $V_{CCI}/2$ — V_{CCI} / 0V
Output Waveform 1 S1 2 x V_{CCO} — t_{PZL} … t_{PLZ} — $V_{CCO}/2$ — ≈V_{CCI} / V_{OL}+0.3V / V_{OL}
t_{PZH} … t_{PHZ}
Output Waveform 2 S1 at GND — $V_{CCO}/2$ … V_{OH} − 0.3V — V_{OH} / 0V

**Voltage Waveforms
Enable and Disable Times**

Figure 4. Load Circuit and Voltage Waveforms
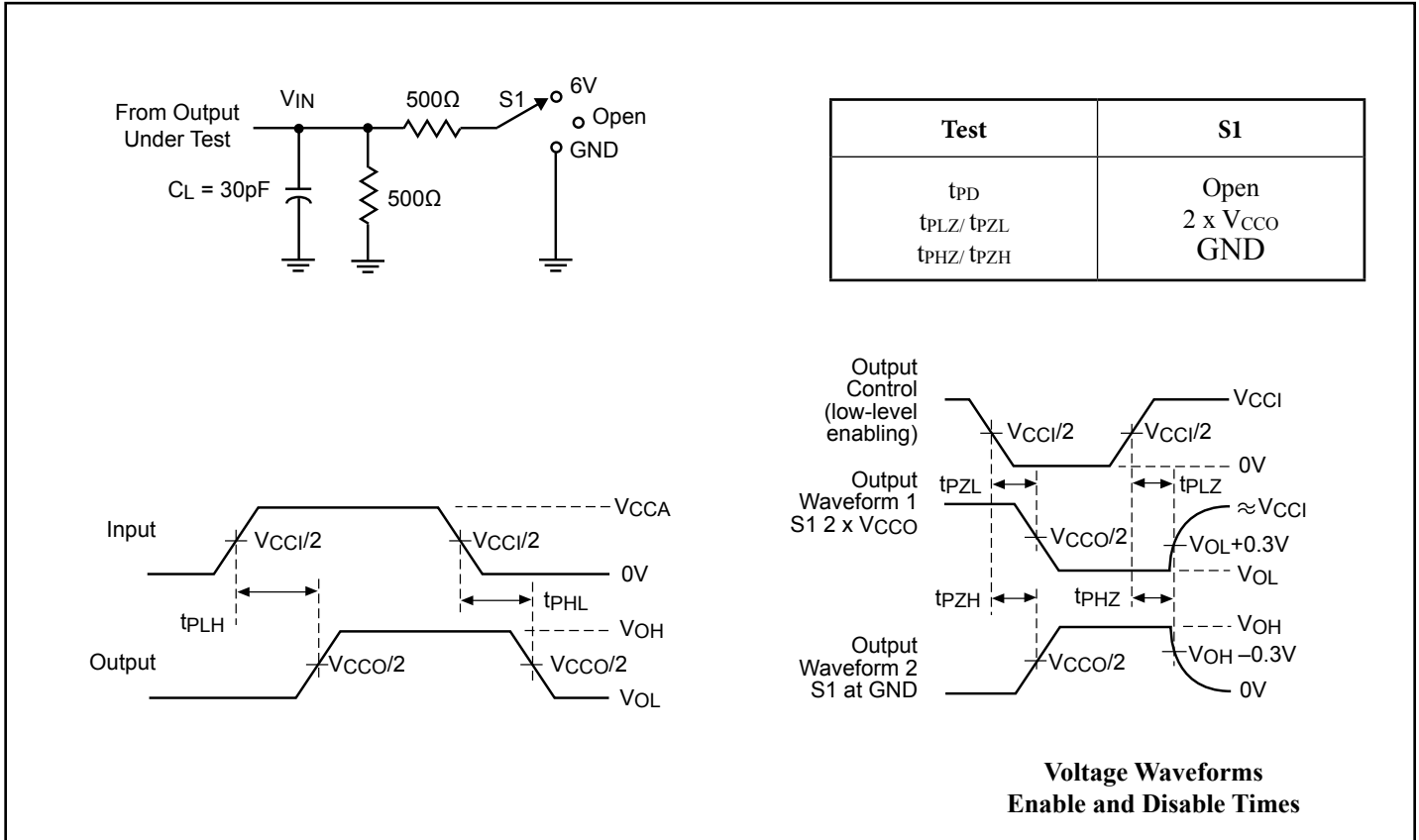
Notes:

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 ≤ **2.5**ns, 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}.

PERICOM®

Packaging Mechanical: 48-Pin TSSOP (A)

DOCUMENT CONTROL NO. PD - 1501
REVISION: G
DATE: 03/09/05

.236 / .244 [6.0 / 6.2] See Note 4

.488 / .496 [12.4 / 12.6] See Note 3

.047 [1.20] Max

SEATING PLANE

.0197 BSC [0.50]

.007 / .010 [0.17 / 0.27]

.002 / .006 [0.05 / 0.15]

0.45 / 0.75 .018 / .030

.319 BSC [8.1]

.004 / .008 [0.09 / 0.20]

[X.XX / X.XX] DENOTES DIMENSIONS IN MILLIMETERS

Note:
1. Controlling dimensions in millimeters.
2. Ref: JEDEC MO-153F/ED
3. Dimension does not include mold flash, protrusions or gate burrs. Mold flash, protrusions and gate burrs shall not exceed 0.15mm per side.
4. Dimension does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25mm per side.
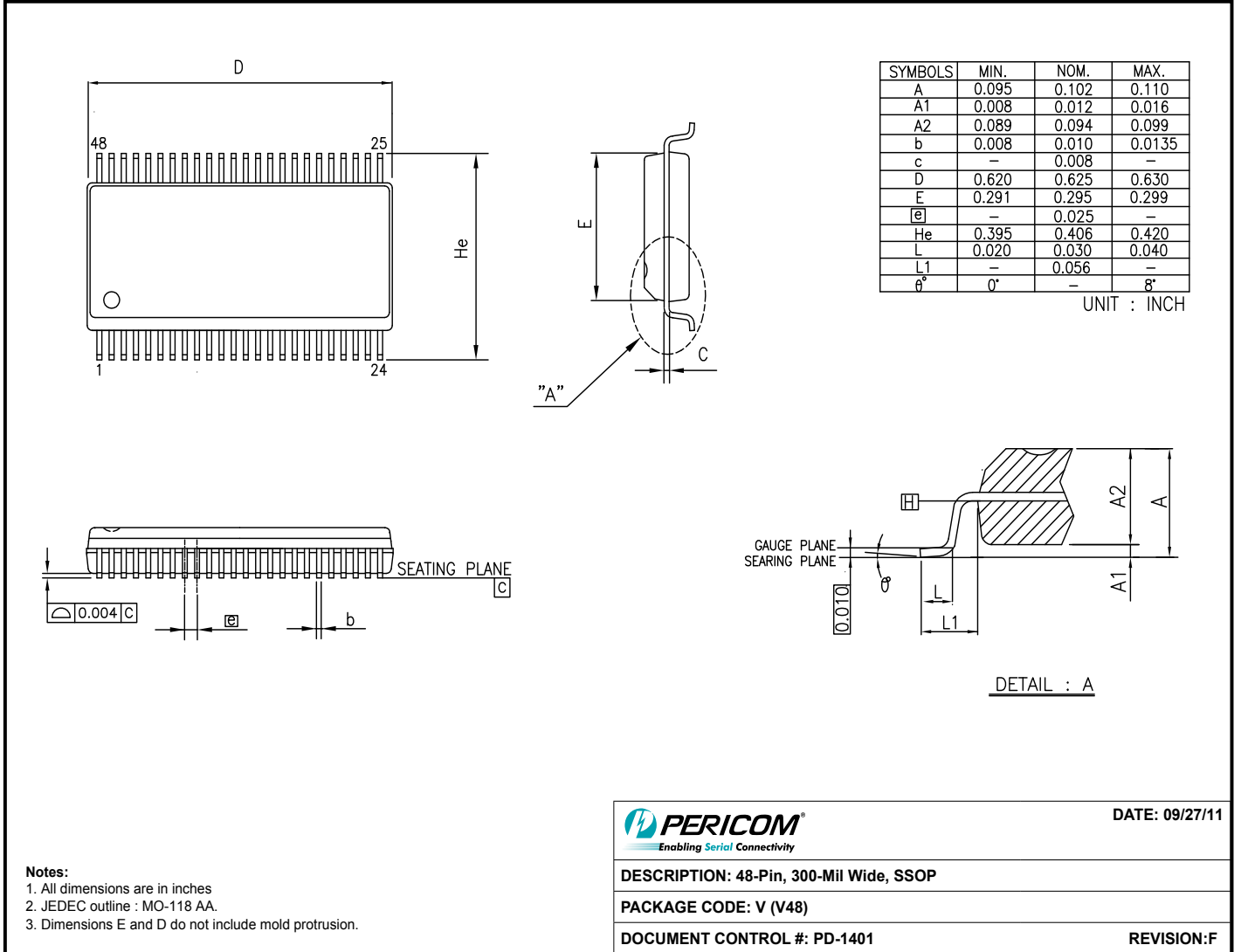
PERICOM®

Pericom Semiconductor Corporation
3545 N. 1st Street, San Jose, CA 95134
1-800-435-2335 • www.pericom.com

DESCRIPTION: 48-Pin 240-Mil Wide TSSOP

PACKAGE CODE: A

Packaging Mechanical: 48-Pin TSSOP (V)

SYMBOLS	MIN.	NOM.	MAX.
A	0.095	0.102	0.110
A1	0.008	0.012	0.016
A2	0.089	0.094	0.099
b	0.008	0.010	0.0135
c	–	0.008	–
D	0.620	0.625	0.630
E	0.291	0.295	0.299
e	–	0.025	–
He	0.395	0.406	0.420
L	0.020	0.030	0.040
L1	–	0.056	–
θ°	0°	–	8°

UNIT : INCH

SEATING PLANE

0.004 C

DETAIL : A

GAUGE PLANE
SEARING PLANE

Notes:
1. All dimensions are in inches
2. JEDEC outline : MO-118 AA.
3. Dimensions E and D do not include mold protrusion.

DATE: 09/27/11

PERICOM
Enabling Serial Connectivity

DESCRIPTION: 48-Pin, 300-Mil Wide, SSOP

PACKAGE CODE: V (V48)

DOCUMENT CONTROL #: PD-1401   **REVISION:F**

Packaging Mechanical: 48-Pin TSSOP (K)

SYMBOL	DIMENSION IN MM		
	MIN.	NOM	MAX.
A			1.20
A1	0.05		0.15
A2	0.80	1.00	1.05
L	0.50	0.60	0.75
E	6.40 BSC.		
D	9.60	9.70	9.80
E1	4.30	4.40	4.50
R	0.09		
R1	0.09		
b	0.13		0.23
b1	0.13	0.16	0.19
c	0.09		0.20
c1	0.09		0.16
L1	1.0 REF.		
e	0.40 BSC.		
θ1	0		8
θ2	12 REF.		
θ3	12 REF.		

SECTION A–A

DETAIL A

NOTE:
1. Refer JEDEC MO–153/CD
2. All dimensions are in mm. Angles in degrees.
3. Package outline dimensions exclude mold flash and metal burr.

PERICOM
Semiconductor Corporation

DATE: 08/29/08

DESCRIPTION: 48-Pin, 173mil wide TVSOP (TSSOP)

PACKAGE CODE: K48

DOCUMENT CONTROL #: PD-1324   **REVISION:** D

08-0442

Ordering Information

Ordering Code	Package Code	Speed Grade	Package Description
PI74AVC164245AE	A	Blank	Pb-free & Green, 48-pin 240-mil wide plastic TSSOP
PI74AVC164245KE	K	Blank	Pb-free & Green, 48-pin 173-mil wide plastic TVSOP
PI74AVC164245AAE	A	A	Pb-free & Green, 48-pin 240-mil wide plastic TSSOP
PI74AVC164245AVE	V	A	Pb-free & Green, 48-pin 300-mil wide plastic SSOP
PI74AVC164245AKE	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/

2. E = Pb-free and Green

3. X Suffix =Tape/Reel