



## PI74AVC+16836

### 2.5V 20-Bit Universal Bus Driver with 3-State Outputs

#### Product Features

- PI74AVC+16836 is designed for low voltage operation,  $V_{CC} = 1.65V$  to  $3.6V$
- True  $\pm 24mA$  Balanced Drive @  $3.3V$
- $I_{OFF}$  supports partial power-down operation
- $3.6V$  I/O Tolerant inputs and outputs
- Meets PC133 SDRAM Registered DIMM Specifications
- All outputs contain a patented DDC (Dynamic Drive Control) circuit that reduces noise without degrading propagation delay
- Industrial operation at  $-40^{\circ}C$  to  $+85^{\circ}C$
- Available Packages:
  - 56-pin 240 mil wide plastic TSSOP (A)
  - 56-pin 173 mil wide plastic TVSOP (K)

#### Product Description

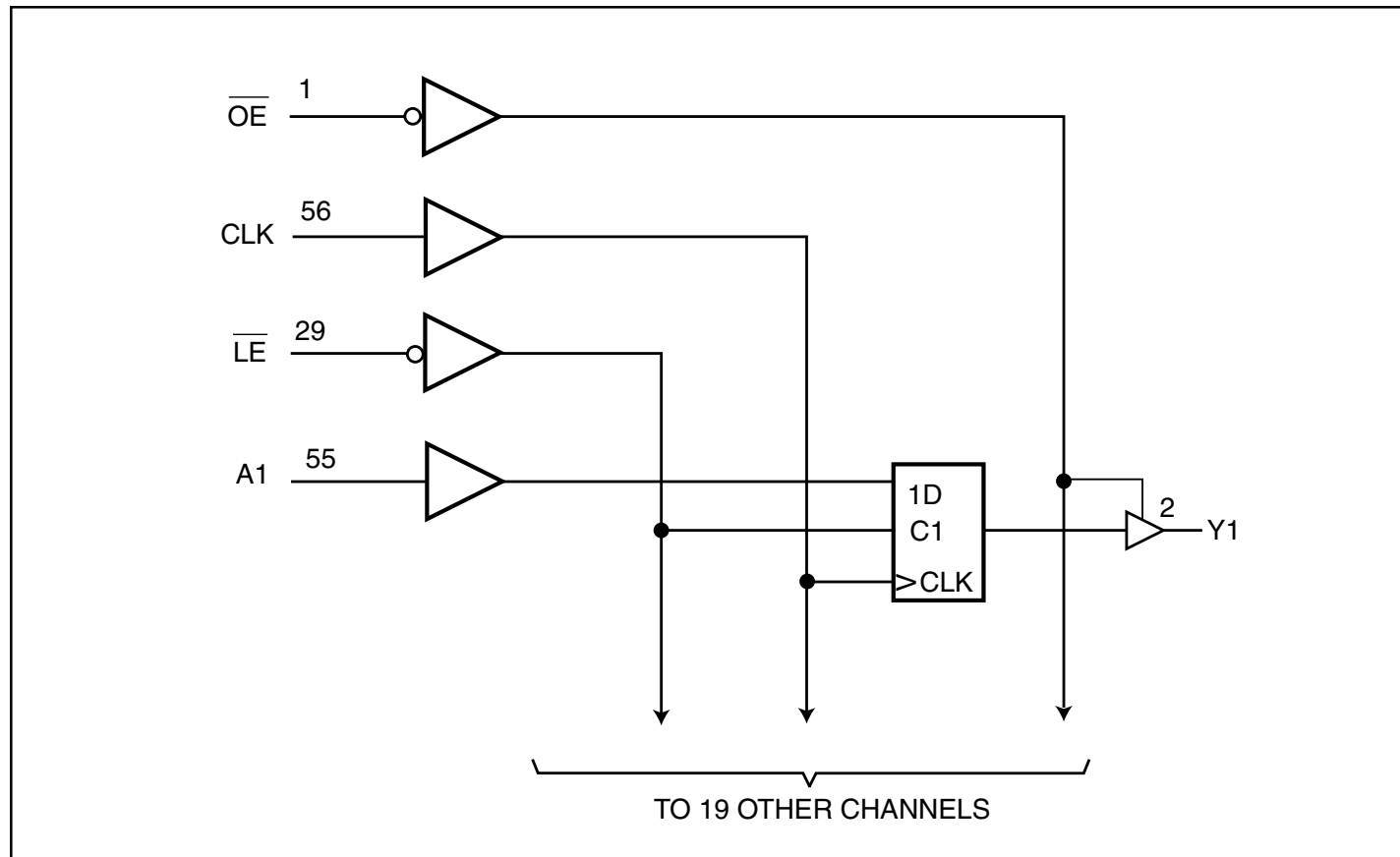
Pericom Semiconductor's PI74AVC+ series of logic circuits are produced using the Company's advanced 0.35 micron CMOS technology, achieving industry leading speed.

The 20-bit PI74AVC+16836 universal bus driver is designed for  $1.65V$  to  $3.6V$   $V_{CC}$  operation.

Data flow from A to Y is controlled by the Output Enable ( $\overline{OE}$ ) input. The device operates in the transparent mode when the latch-enable ( $\overline{LE}$ ) input is LOW. When  $\overline{LE}$  is HIGH, the A data is latched if the clock (CLK) input is held at a high or low logic level. If  $\overline{LE}$  is HIGH, the A data is stored in the latch/flip-flop on the low-to-high transition of CLK. When  $\overline{OE}$  is HIGH, the outputs are in the high-impedance state, but all the inputs are enabled and data is capable of being stored in the register.

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

#### Logic Block Diagram



## Product Pin Description

| Pin Name        | Description                      |
|-----------------|----------------------------------|
| $\overline{OE}$ | Output Enable Input (Active LOW) |
| $\overline{LE}$ | Latch Enable (Active LOW)        |
| CLK             | Clock Input                      |
| A               | Data Input                       |
| Y               | Data Output                      |
| GND             | Ground                           |
| Vcc             | Power                            |

## Truth Table<sup>(1)</sup>

| Inputs          |                 |        |   | Outputs<br>Y                  |
|-----------------|-----------------|--------|---|-------------------------------|
| $\overline{OE}$ | $\overline{LE}$ | CLK    | A |                               |
| H               | X               | X      | X | Z                             |
| L               | L               | X      | L | L                             |
| L               | L               | X      | H | H                             |
| L               | H               | ↑      | L | L                             |
| L               | H               | ↑      | H | H                             |
| L               | H               | L or H | X | Y <sub>0</sub> <sup>(2)</sup> |

## Pin Configuration

|                 |    |    |                 |
|-----------------|----|----|-----------------|
| $\overline{OE}$ | 1  | 56 | CLK             |
| Y1              | 2  | 55 | A1              |
| Y2              | 3  | 54 | A2              |
| GND             | 4  | 53 | GND             |
| Y3              | 5  | 52 | A3              |
| Y4              | 6  | 51 | A4              |
| Vcc             | 7  | 50 | Vcc             |
| Y5              | 8  | 49 | A5              |
| Y6              | 9  | 48 | A6              |
| Y7              | 10 | 47 | A7              |
| GND             | 11 | 46 | GND             |
| Y8              | 12 | 45 | A8              |
| Y9              | 13 | 44 | A9              |
| Y10             | 14 | 43 | A10             |
| Y11             | 15 | 42 | A11             |
| Y12             | 16 | 41 | A12             |
| Y13             | 17 | 40 | A13             |
| GND             | 18 | 39 | GND             |
| Y14             | 19 | 38 | A14             |
| Y15             | 20 | 37 | A15             |
| Y16             | 21 | 36 | A16             |
| Vcc             | 22 | 35 | Vcc             |
| Y17             | 23 | 34 | A17             |
| Y18             | 24 | 33 | A18             |
| GND             | 25 | 32 | GND             |
| Y19             | 26 | 31 | A19             |
| Y20             | 27 | 30 | A20             |
| NC              | 28 | 29 | $\overline{LE}$ |

### Note:

- 1 H = High Signal Level  
L = Low Signal Level  
Z = High Impedance  
↑ = Transition LOW-to-HIGH  
X = Irrelevant
2. Output level before the indicated steady-state input conditions were established.

## Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

|                                                                                                 |                        |
|-------------------------------------------------------------------------------------------------|------------------------|
| Supply voltage range, $V_{CC}$ .....                                                            | -0.5V to +4.6V         |
| Input voltage range, $V_I$ .....                                                                | -0.5V to +4.6V         |
| Voltage range applied to any output in the high-impedance or power-off state, $V_O^{(1)}$ ..... | -0.5V to +4.6V         |
| Voltage range applied to any output in the high or low state, $V_O^{(1,2)}$ .....               | -0.5V to $V_{CC}+0.5V$ |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....                                               | -50mA                  |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....                                              | -50mA                  |
| Continuous output current, $I_O$ .....                                                          | $\pm 50mA$             |
| Continuous current through each $V_{CC}$ or GND .....                                           | $\pm 100mA$            |
| Package thermal impedance, $\theta_{JA}^{(3)}$ : package A .....                                | 64°C/W                 |
| package K .....                                                                                 | 48°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.

### Notes:

1. Input & output negative-voltage ratings may be exceeded if the input and output current rating are observed.
2. Output positive-voltage rating may be exceeded up to 4.6V maximum if the output current rating is observed.
3. The package thermal impedance is calculated in accordance with JESD 51.

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

|                                                        |                           | Min.                 | Max.                 | Units |
|--------------------------------------------------------|---------------------------|----------------------|----------------------|-------|
| $V_{CC}$ Supply Voltage                                | Operating                 | 1.65                 | 3.6                  | V     |
|                                                        | Data retention only       | 1.2                  |                      |       |
| $V_{IH}$ High-level Input Voltage                      | $V_{CC} = 1.2V$           | $V_{CC}$             |                      |       |
|                                                        | $V_{CC} = 1.65V$ to 1.95V | $0.65 \times V_{CC}$ |                      |       |
|                                                        | $V_{CC} = 2.3V$ to 2.7V   | 1.7                  |                      |       |
|                                                        | $V_{CC} = 3V$ to 3.6V     | 2                    |                      |       |
| $V_{IL}$ Low-level Input Voltage                       | $V_{CC} = 1.2V$           |                      | Gnd                  |       |
|                                                        | $V_{CC} = 1.65V$ to 1.95V |                      | $0.35 \times V_{CC}$ |       |
|                                                        | $V_{CC} = 2.3V$ to 2.7V   |                      | 0.7                  |       |
|                                                        | $V_{CC} = 3V$ to 3.6V     |                      | 0.8                  |       |
| $V_I$ Input Voltage                                    |                           | 0                    | 3.6                  |       |
| $V_O$ Output Voltage                                   | Active State              | 0                    | $V_{CC}$             |       |
|                                                        | 3-State                   | 0                    | 3.6                  |       |
| $I_{OH}$ High-level output current                     | $V_{CC} = 1.65V$ to 1.95V |                      | -6                   | mA    |
|                                                        | $V_{CC} = 2.3V$ to 2.7V   |                      | -12                  |       |
|                                                        | $V_{CC} = 3V$ to 3.6V     |                      | -24                  |       |
| $I_{OL}$ Low-level output current                      | $V_{CC} = 1.65V$ to 1.95V |                      | 6                    |       |
|                                                        | $V_{CC} = 2.3V$ to 2.7V   |                      | 12                   |       |
|                                                        | $V_{CC} = 3V$ to 3.6V     |                      | 24                   |       |
| $\Delta t/\Delta v$ Input transition rise or fall rate | $V_{CC} = 1.65V$ to 3.6V  |                      | 5                    | ns/V  |
| $T_A$ Operating free-air temperature                   |                           | -40                  | 85                   | °C    |

### Notes:

1. All unused inputs must be held at  $V_{CC}$  or GND to ensure proper device operation.

**DC Electrical Characteristics (Over the Operating Range,  $T_A = -40^{\circ}\text{C} + 85^{\circ}\text{C}$ )**

| Parameters |                | Test Conditions <sup>(1)</sup>                 | $V_{CC}$      | Min.                   | Max.      | Units         |
|------------|----------------|------------------------------------------------|---------------|------------------------|-----------|---------------|
| $V_{OH}$   |                | $I_{OH} = -100\mu\text{A}$                     | 1.65V to 3.6V | $V_{CC} - 0.2\text{V}$ |           | V             |
|            |                | $I_{OH} = -6\text{mA}$ $V_{IH} = 1.07\text{V}$ | 1.65V         | 1.2                    |           |               |
|            |                | $I_{OH} = -12\text{mA}$ $V_{IH} = 1.7\text{V}$ | 2.3V          | 1.75                   |           |               |
|            |                | $I_{OH} = -24\text{mA}$ $V_{IH} = 2\text{V}$   | 3V            | 2.0                    |           |               |
| $V_{OL}$   |                | $I_{OL} = 100\mu\text{A}$                      | 1.65V to 3.6V |                        | 0.2       |               |
|            |                | $I_{OL} = 6\text{mA}$ $V_{IH} = 0.57\text{V}$  | 1.65V         |                        | 0.45      |               |
|            |                | $I_{OL} = 12\text{mA}$ $V_{IH} = 0.7\text{V}$  | 2.3V          |                        | 0.55      |               |
|            |                | $I_{OL} = 24\text{mA}$ $V_{IH} = 0.8\text{V}$  | 3V            |                        | 0.8       |               |
| $I_I$      | Control Inputs | $V_I = V_{CC}$ or GND                          | 3.6V          |                        | $\pm 2.5$ | $\mu\text{A}$ |
| $I_{OFF}$  |                | $V_I$ or $V_O = 3.6\text{V}$                   | 0             |                        | $\pm 10$  |               |
| $I_{OZ}$   |                | $V_I = V_{CC}$ or GND                          | 3.6V          |                        | $\pm 10$  |               |
| $I_{CC}$   |                | $V_O = V_{CC}$ or GND $I_O = 0$                | 3.6V          |                        | 40        |               |
| $C_I$      | Control Inputs | $V_I = V_{CC}$ or GND                          | 2.5V          |                        | 4         | pF            |
|            |                |                                                | 3.3V          |                        | 4         |               |
|            | Data Inputs    |                                                | 2.5V          |                        | 6         |               |
|            |                |                                                | 3.3V          |                        | 6         |               |
| $C_O$      | Outputs        | $V_O = V_{CC}$ or GND                          | 2.5V          |                        | 8         |               |
|            |                |                                                | 3.3V          |                        | 8         |               |

**Note:** Typical values are measured at  $T_A = 25^{\circ}\text{C}$ .

**Timing Requirements** (Over recommended operating free-air temperature range, unless otherwise noted, see Figures 1 thru 4)

|                                  |                    |                 | V <sub>CC</sub> = 1.2V |      | V <sub>CC</sub> = 1.5V<br>±0.1V |      | V <sub>CC</sub> = 1.8V<br>±0.15V |      | V <sub>CC</sub> = 2.5V<br>±0.2V |      | V <sub>CC</sub> = 3.3V<br>±0.3V |      | Units |
|----------------------------------|--------------------|-----------------|------------------------|------|---------------------------------|------|----------------------------------|------|---------------------------------|------|---------------------------------|------|-------|
|                                  |                    |                 | Min.                   | Max. | Min.                            | Max. | Min.                             | Max. | Min.                            | Max. | Min.                            | Max. |       |
| f <sub>clock</sub>               | Clock Frequency    |                 |                        |      |                                 |      |                                  | 180  |                                 | 180  |                                 | 180  | MHz   |
| t <sub>w</sub><br>Pulse Duration | LE Low             |                 |                        |      |                                 |      | 2.0                              |      | 1.2                             |      | 1.0                             |      | ns    |
|                                  | CLK High or Low    |                 |                        |      |                                 |      | 2.0                              |      | 1.2                             |      | 1.0                             |      |       |
| t <sub>su</sub><br>Setup Time    | Data before CLK↑   |                 |                        |      |                                 |      | 1.4                              |      | 1.2                             |      | 1.0                             |      |       |
|                                  | Data before<br>LE↑ | CLK High        |                        |      |                                 |      | 1.4                              |      | 1.2                             |      | 1.0                             |      |       |
|                                  |                    | CLK Low         |                        |      |                                 |      | 1.4                              |      | 1.2                             |      | 1.0                             |      |       |
| t <sub>h</sub> Hold Time         | Data after CLK↑    |                 |                        |      |                                 |      | 1.0                              |      | 0.8                             |      | 0.6                             |      |       |
|                                  | Data after LE↑     | CLK High or Low |                        |      |                                 |      | 1.0                              |      | 0.8                             |      | 0.6                             |      |       |

### Switching Characteristics over recommended operating free-air temperature range

(unless otherwise noted, see Figures 1 thru 4)

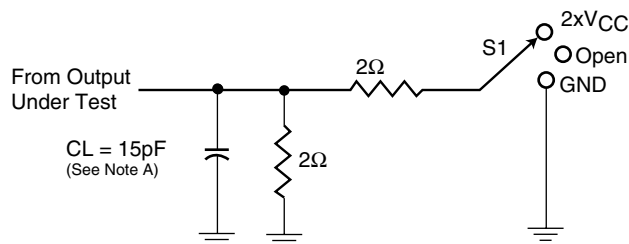
| Parameters       | From<br>(Input) | To<br>(Output) | V <sub>CC</sub> = 1.2V |      | V <sub>CC</sub> = 1.5V<br>±0.1V |      | V <sub>CC</sub> = 1.8V<br>±0.15V |      | V <sub>CC</sub> = 2.5V<br>±0.2V |      | V <sub>CC</sub> = 3.3V<br>±0.3V |      | Units |
|------------------|-----------------|----------------|------------------------|------|---------------------------------|------|----------------------------------|------|---------------------------------|------|---------------------------------|------|-------|
|                  |                 |                | Min.                   | Max. | Min.                            | Max. | Min.                             | Max. | Min.                            | Max. | Min.                            | Max. |       |
| f <sub>max</sub> |                 |                |                        |      |                                 |      | 180                              |      | 180                             |      | 180                             |      | MHz   |
| t <sub>pd</sub>  | A               | Y              |                        |      |                                 |      | 1.0                              | 4.5  | 0.8                             | 3.0  | 0.7                             | 2.4  | ns    |
|                  | LE              |                |                        |      |                                 |      | 1.0                              | 5.0  | 0.8                             | 3.3  | 0.7                             | 2.5  |       |
|                  | CLK             |                |                        |      |                                 |      | 1.0                              | 4.5  | 0.8                             | 3.0  | 0.7                             | 2.5  |       |
| t <sub>en</sub>  | OE              |                |                        |      |                                 |      | 1.5                              | 5.5  | 1.0                             | 4.5  | 1.0                             | 4.0  |       |
| t <sub>dis</sub> | OE              |                |                        |      |                                 |      | 1.5                              | 5.0  | 1.0                             | 4.5  | 1.0                             | 4.0  |       |

### Operating Characteristics, T<sub>A</sub> = 25°C

| Parameters                                    |                  | Test Conditions                     | V <sub>CC</sub> = 1.8V<br>±0.1V | V <sub>CC</sub> = 2.5V<br>±0.2V | V <sub>CC</sub> = 3.3V<br>±0.3V | Units |
|-----------------------------------------------|------------------|-------------------------------------|---------------------------------|---------------------------------|---------------------------------|-------|
|                                               |                  |                                     | Typical                         | Typical                         | Typical                         |       |
| C <sub>pd</sub> Power Dissipation Capacitance | Outputs Enabled  | C <sub>L</sub> = 0pF,<br>f = 10 MHz | 48                              | 50                              | 55                              | pF    |
|                                               | Outputs Disabled |                                     | 25                              | 28                              | 32                              |       |

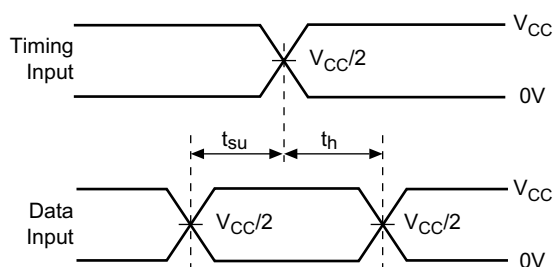
## PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 1.2V \text{ AND } 1.5V \pm 0.1V$

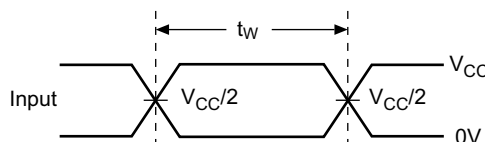


**Load Circuit**

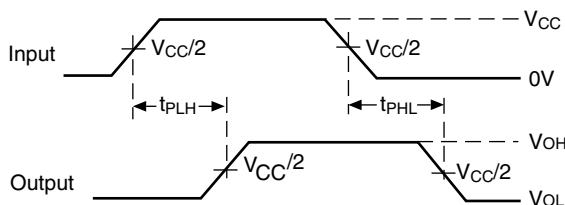
| Test                                               | S1                               |
|----------------------------------------------------|----------------------------------|
| $t_{pd}$<br>$t_{PLZ}/t_{PZL}$<br>$t_{PHZ}/t_{PZH}$ | Open<br>$2 \times V_{CC}$<br>GND |



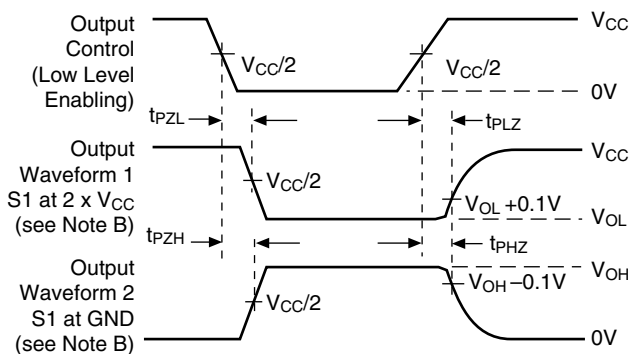
**Voltage Waveforms  
Setup and Hold Times**



**Voltage Waveforms  
Pulse Duration**



**Voltage Waveforms  
Propagation Delay Times**



**Voltage Waveforms  
Enable and Disable Times**

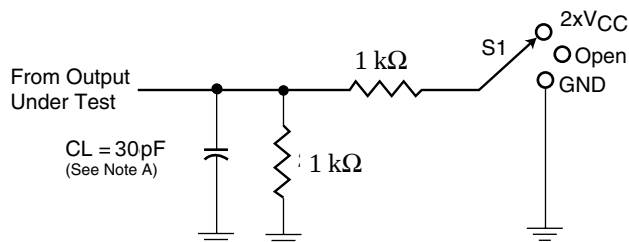
**Figure 1. Load Circuit and Voltage Waveforms**

### 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 impulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50\Omega$ ,  $t_R \leq 2.0ns$ ,  $t_F \leq 2.0ns$ .
- 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  $t_{pd}$

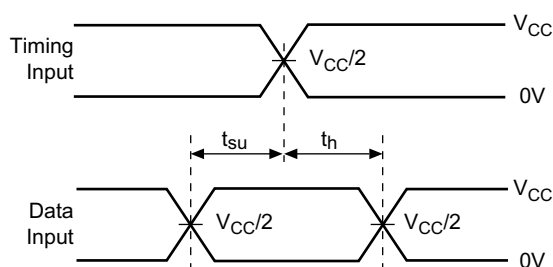
## PARAMETER MEASUREMENT INFORMATION

$$V_{CC} = 1.8V \pm 0.15V$$

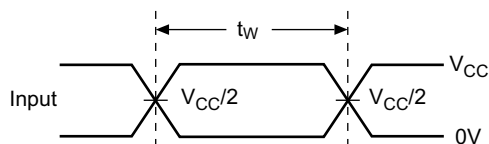


**Load Circuit**

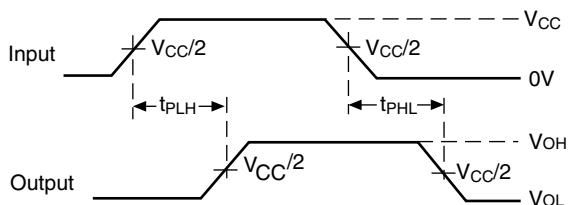
| Test                                               | S1                     |
|----------------------------------------------------|------------------------|
| $t_{pd}$<br>$t_{PLZ}/t_{PZL}$<br>$t_{PHZ}/t_{PZH}$ | Open<br>2 x VCC<br>GND |



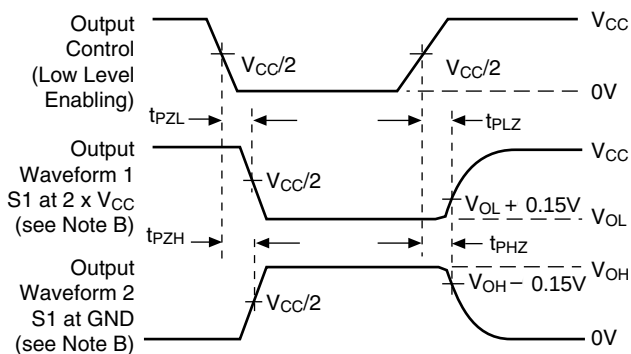
**Voltage Waveforms  
Setup and Hold Times**



**Voltage Waveforms  
Pulse Duration**



**Voltage Waveforms  
Propagation Delay Times**



**Voltage Waveforms  
Enable and Disable Times**

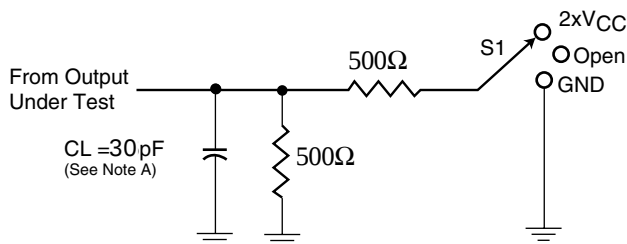
**Figure 2. Load Circuit and Voltage Waveforms**

### 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 impulses are supplied by generators having these characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50\Omega$ ,  $t_R \leq 0.5\text{ns}$ ,  $t_F \leq 0.5\text{ns}$ .
- 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  $t_{pd}$

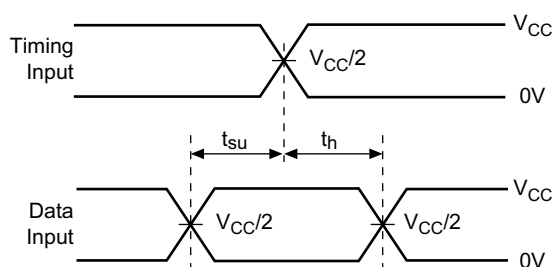
## PARAMETER MEASUREMENT INFORMATION

$$V_{CC} = 2.5V \pm 0.2V$$

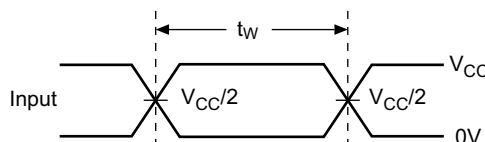


**Load Circuit**

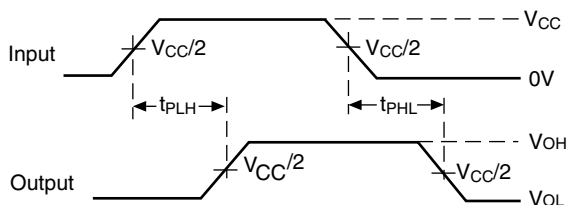
| Test                                               | S1                          |
|----------------------------------------------------|-----------------------------|
| $t_{pd}$<br>$t_{PLZ}/t_{PZL}$<br>$t_{PHZ}/t_{PZH}$ | Open<br>2 x $V_{CC}$<br>GND |



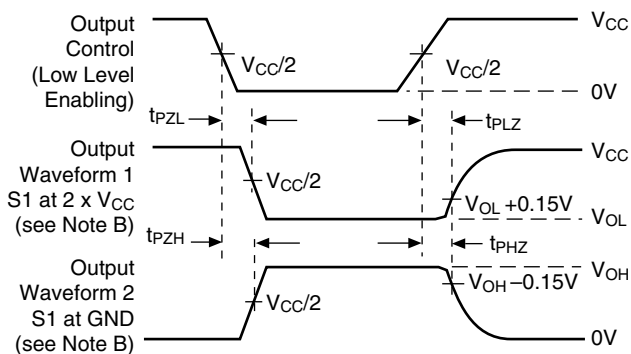
**Voltage Waveforms  
Setup and Hold Times**



**Voltage Waveforms  
Pulse Duration**



**Voltage Waveforms  
Propagation Delay Times**



**Voltage Waveforms  
Enable and Disable Times**

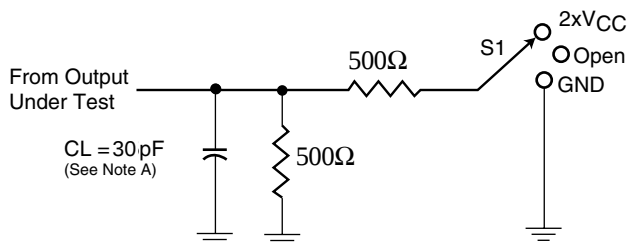
**Figure 3. Load Circuit and Voltage Waveforms**

### 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 impulses are supplied by generators having these characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50\Omega$ ,  $t_R \leq 0.5\text{ns}$ ,  $t_F \leq 0.5\text{ns}$ .
- 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  $t_{pd}$

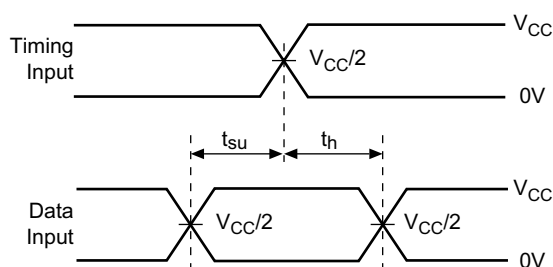
## PARAMETER MEASUREMENT INFORMATION

$$V_{CC} = 3.3V \pm 0.3V$$

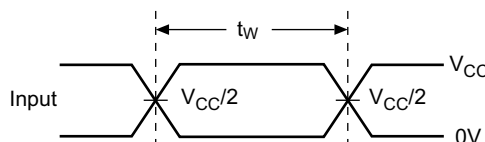


**Load Circuit**

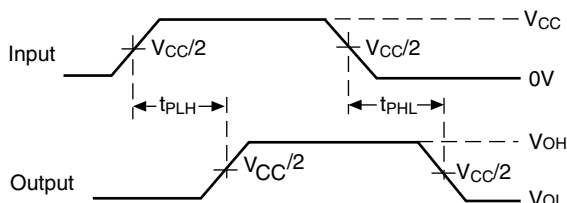
| Test                                                                                        | S1                                 |
|---------------------------------------------------------------------------------------------|------------------------------------|
| t <sub>pd</sub><br>t <sub>PLZ</sub> /t <sub>PZL</sub><br>t <sub>PHZ</sub> /t <sub>PZH</sub> | Open<br>2 x V <sub>CC</sub><br>GND |



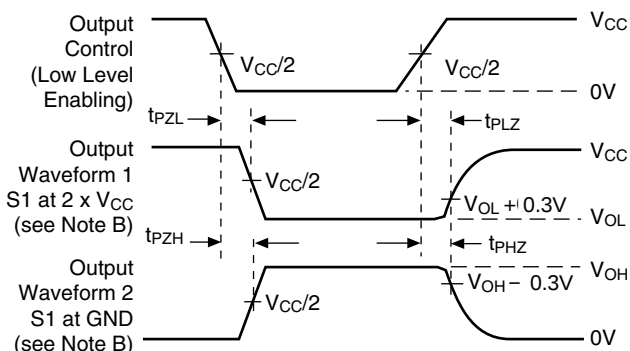
**Voltage Waveforms  
Setup and Hold Times**



**Voltage Waveforms  
Pulse Duration**



**Voltage Waveforms  
Propagation Delay Times**



**Voltage Waveforms  
Enable and Disable Times**

**Figure 4. Load Circuit and Voltage Waveforms**

### Notes:

- C<sub>L</sub> 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 impulses are supplied by generators having these characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50Ω, t<sub>R</sub> ≤ 0.5ns, t<sub>F</sub> ≤ 0.5ns.
- The outputs are measured one at a time with one transition per measurement.
- t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>
- t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>
- t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>