



## 3.3V CMOS 18-BIT UNIVERSAL BUS DRIVER WITH 3-STATE OUTPUTS

**IDT74ALVCF162835A**

### FEATURES:

- 0.5 MICRON CMOS Technology
- Typical  $t_{SK(o)}$  (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- $V_{CC} = 3.3V \pm 0.3V$ , Normal Range
- $V_{CC} = 2.7V$  to  $3.6V$ , Extended Range
- $V_{CC} = 2.5V \pm 0.2V$
- CMOS power levels ( $0.4\mu W$  typ. static)
- Rail-to-Rail output swing for increased noise margin
- Available in TSSOP and TVSOP packages

### DRIVE FEATURES:

- Balanced Output Drivers:  $\pm 18mA$
- Low switching noise

### APPLICATIONS:

- SDRAM Modules
- PC Motherboards
- Workstations

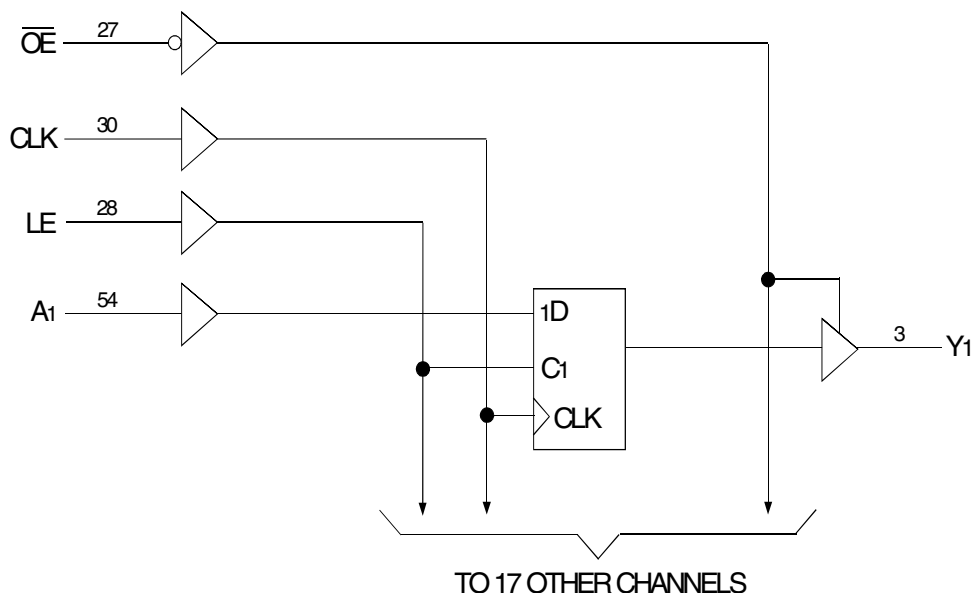
### DESCRIPTION:

This 18-bit universal bus driver is built using advanced dual metal CMOS technology. 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 (LE) input is high. The A data is latched if the clock (CLK) input is held at a high or low logic level. If LE is low, 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.

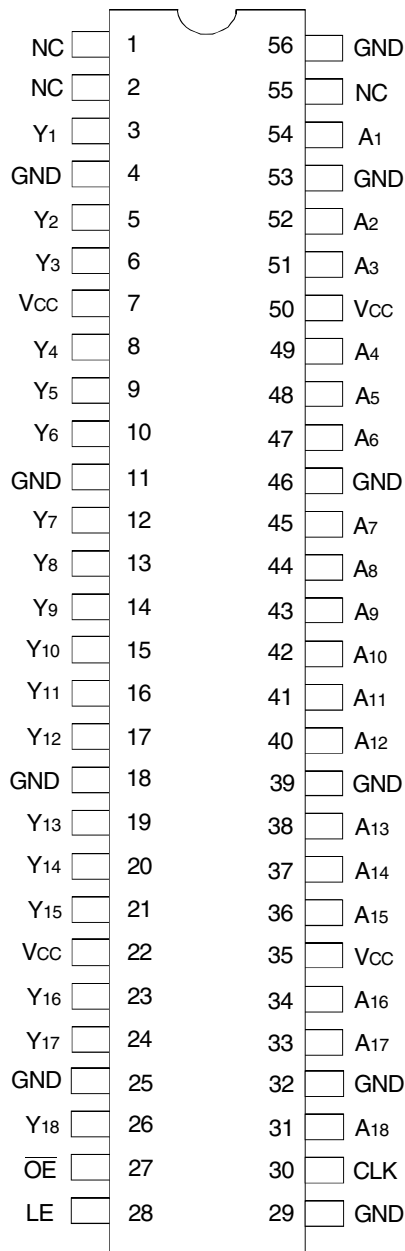
The ALVCF162835A has series resistors in the device output structure which will reduce switching noise in 128MB and 256MB SDRAM modules. Designed with a drive capability of  $\pm 18mA$ , the ALVCF162835A is a mid-way drive between the ALVC162835 ( $\pm 12mA$ ) and ALVC16835 ( $\pm 24mA$ ).

The ALVCF162835A is a faster version of the ALVCF162835 or ALVC162835. It is suitable for PC133 applications and particularly SDRAM Modules clocked at 133 MHz.

### FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



TSSOP/TVSOP  
TOP VIEW

## PIN DESCRIPTION

| Pin Names       | Description                               |
|-----------------|-------------------------------------------|
| $\overline{OE}$ | 3-State Output Enable Inputs (Active LOW) |
| CLK             | Register Input Clock                      |
| LE              | Latch Enable (Transparent HIGH)           |
| Ax              | Data Inputs                               |
| Yx              | 3-State Outputs                           |

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                             | Description                                                                      | Max                          | Unit |
|------------------------------------|----------------------------------------------------------------------------------|------------------------------|------|
| VTERM <sup>(2)</sup>               | Terminal Voltage with Respect to GND                                             | -0.5 to +4.6                 | V    |
| VTERM <sup>(3)</sup>               | Terminal Voltage with Respect to GND                                             | -0.5 to V <sub>CC</sub> +0.5 | V    |
| TSTG                               | Storage Temperature                                                              | -65 to +150                  | °C   |
| I <sub>OUT</sub>                   | DC Output Current                                                                | -50 to +50                   | mA   |
| I <sub>IK</sub>                    | Continuous Clamp Current, V <sub>I</sub> < 0 or V <sub>I</sub> > V <sub>CC</sub> | ±50                          | mA   |
| I <sub>OK</sub>                    | Continuous Clamp Current, V <sub>O</sub> < 0                                     | -50                          | mA   |
| I <sub>CC</sub><br>I <sub>SS</sub> | Continuous Current through each V <sub>CC</sub> or GND                           | ±100                         | mA   |

### NOTES:

- Stresses greater than those listed under ABSOLUTE 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.
- V<sub>CC</sub> terminals.
- All terminals except V<sub>CC</sub>.

## CAPACITANCE (T<sub>A</sub> = +25°C, F = 1.0MHz)

| Symbol           | Parameter <sup>(1)</sup> | Conditions            | Min. | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 4    | 5    | 6    | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | —    | 7    | 9    | pF   |
| C <sub>OUT</sub> | I/O Port Capacitance     | V <sub>IN</sub> = 0V  | —    | 7    | 9    | pF   |

### NOTE:

- As applicable to the device type.

## FUNCTION TABLE<sup>(1)</sup>

| Inputs          |    |     |    | Outputs                       |
|-----------------|----|-----|----|-------------------------------|
| $\overline{OE}$ | LE | CLK | Ax | Yx                            |
| H               | X  | X   | X  | Z                             |
| L               | H  | X   | L  | L                             |
| L               | H  | X   | H  | H                             |
| L               | L  | ↑   | L  | L                             |
| L               | L  | ↑   | H  | H                             |
| L               | L  | H   | X  | Y <sub>0</sub> <sup>(2)</sup> |
| L               | L  | L   | X  | Y <sub>0</sub> <sup>(3)</sup> |

### NOTES:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
Z = High-Impedance  
↑ = LOW-to-HIGH Transition
- Output level before indicated steady-state input conditions were established, provided that CLK is HIGH before LE went LOW.
- Output level before the indicated steady-state input conditions were established.

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

| Symbol                              | Parameter                                              | Test Conditions                                                                |                    | Min. | Typ. <sup>(1)</sup> | Max.     | Unit          |
|-------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------|--------------------|------|---------------------|----------|---------------|
| $V_{IH}$                            | Input HIGH Voltage Level                               | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                        |                    | 1.7  | —                   | —        | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                        |                    | 2    | —                   | —        |               |
| $V_{IL}$                            | Input LOW Voltage Level                                | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                        |                    | —    | —                   | 0.7      | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                        |                    | —    | —                   | 0.8      |               |
| $I_{IH}$                            | Input HIGH Current                                     | $V_{CC} = 3.6\text{V}$                                                         | $V_I = V_{CC}$     | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| $I_{IL}$                            | Input LOW Current                                      | $V_{CC} = 3.6\text{V}$                                                         | $V_I = \text{GND}$ | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| $I_{OZH}$                           | High Impedance Output Current<br>(3-State Output pins) | $V_{CC} = 3.6\text{V}$                                                         | $V_O = V_{CC}$     | —    | —                   | $\pm 10$ | $\mu\text{A}$ |
| $I_{OZL}$                           |                                                        |                                                                                | $V_O = \text{GND}$ | —    | —                   | $\pm 10$ |               |
| $V_{IK}$                            | Clamp Diode Voltage                                    | $V_{CC} = 2.3\text{V}$ , $I_{IN} = -18\text{mA}$                               |                    | —    | -0.7                | -1.2     | V             |
| $V_H$                               | Input Hysteresis                                       | $V_{CC} = 3.3\text{V}$                                                         |                    | —    | 100                 | —        | mV            |
| $I_{CCL}$<br>$I_{CCH}$<br>$I_{CCZ}$ | Quiescent Power Supply Current                         | $V_{CC} = 3.6\text{V}$<br>$V_{IN} = \text{GND}$ or $V_{CC}$                    |                    | —    | 0.1                 | 40       | $\mu\text{A}$ |
| $\Delta I_{CC}$                     | Quiescent Power Supply Current Variation               | One input at $V_{CC} - 0.6\text{V}$ , other inputs at $V_{CC}$ or $\text{GND}$ |                    | —    | —                   | 750      | $\mu\text{A}$ |

**NOTE:**

1. Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.

## OUTPUT DRIVE CHARACTERISTICS

| Symbol   | Parameter           | Test Conditions <sup>(1)</sup>          |                          | Min.           | Max. | Unit |
|----------|---------------------|-----------------------------------------|--------------------------|----------------|------|------|
| $V_{OH}$ | Output HIGH Voltage | $V_{CC} = 2.3\text{V}$ to $3.6\text{V}$ | $I_{OH} = -0.1\text{mA}$ | $V_{CC} - 0.2$ | —    | V    |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OH} = -6\text{mA}$   | 1.9            | —    |      |
|          |                     |                                         | $I_{OH} = -8\text{mA}$   | 1.7            | —    |      |
|          |                     | $V_{CC} = 2.7\text{V}$                  | $I_{OH} = -6\text{mA}$   | 2.2            | —    |      |
|          |                     |                                         | $I_{OH} = -12\text{mA}$  | 2              | —    |      |
|          |                     | $V_{CC} = 3\text{V}$                    | $I_{OH} = -8\text{mA}$   | 2.4            | —    |      |
|          |                     |                                         | $I_{OH} = -18\text{mA}$  | 2              | —    |      |
| $V_{OL}$ | Output LOW Voltage  | $V_{CC} = 2.3\text{V}$ to $3.6\text{V}$ | $I_{OL} = 0.1\text{mA}$  | —              | 0.2  | V    |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OL} = 6\text{mA}$    | —              | 0.4  |      |
|          |                     |                                         | $I_{OL} = 8\text{mA}$    | —              | 0.55 |      |
|          |                     | $V_{CC} = 2.7\text{V}$                  | $I_{OL} = 6\text{mA}$    | —              | 0.4  |      |
|          |                     |                                         | $I_{OL} = 12\text{mA}$   | —              | 0.6  |      |
|          |                     | $V_{CC} = 3\text{V}$                    | $I_{OL} = 8\text{mA}$    | —              | 0.55 |      |
|          |                     |                                         | $I_{OL} = 18\text{mA}$   | —              | 0.8  |      |

**NOTE:**

1.  $V_{IH}$  and  $V_{IL}$  must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate  $V_{CC}$  range.  
 $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

## OPERATING CHARACTERISTICS, $T_A = 25^\circ\text{C}$

| Symbol | Parameter                                      | Test Conditions     | Vcc = 2.5V $\pm$ 0.2V | Vcc = 3.3V $\pm$ 0.3V | Unit |
|--------|------------------------------------------------|---------------------|-----------------------|-----------------------|------|
|        |                                                |                     | Typical               | Typical               |      |
| CPD    | Power Dissipation Capacitance Outputs enabled  | CL = 0pF, f = 10MHz | 30                    | 35                    | pF   |
| CPD    | Power Dissipation Capacitance Outputs disabled |                     | 12.5                  | 14                    |      |

## SWITCHING CHARACTERISTICS<sup>(1)</sup>

| Symbol       | Parameter                                               | Vcc = 2.5V $\pm$ 0.2V |      | Vcc = 2.7V |      | Vcc = 3.3V $\pm$ 0.3V |      | Unit |
|--------------|---------------------------------------------------------|-----------------------|------|------------|------|-----------------------|------|------|
|              |                                                         | Min.                  | Max. | Min.       | Max. | Min.                  | Max. |      |
| fCLOCK       |                                                         | 150                   | —    | 150        | —    | 150                   | —    | MHz  |
| tPLH<br>tPHL | Propagation Delay<br>Ax to Yx                           | 1                     | 4    | —          | 4.6  | 1                     | 3.5  | ns   |
| tPLH<br>tPHL | Propagation Delay<br>LE to Yx                           | 1.3                   | 5.5  | —          | 5.4  | 1.3                   | 4.6  | ns   |
| tPLH<br>tPHL | Propagation Delay<br>CLK to Yx                          | 1.4                   | 5.9  | —          | 5.6  | 1.4                   | 3.5  | ns   |
| tPZH<br>tPZL | Output Enable Time<br>$\overline{\text{OE}}$ to Yx      | 1.4                   | 5.9  | —          | 6    | 1.1                   | 5    | ns   |
| tPHZ<br>tPLZ | Output Disable Time<br>$\overline{\text{OE}}$ to Yx     | 1                     | 4.7  | —          | 4.6  | 1.3                   | 4.2  | ns   |
| tW           | Pulse Duration, LE HIGH                                 | 3.3                   | —    | 3.3        | —    | 3.3                   | —    | ns   |
| tW           | Pulse Duration, CLK HIGH or LOW                         | 3.3                   | —    | 3.3        | —    | 3.3                   | —    | ns   |
| tSU          | Set-up Time, data before CLK $\uparrow$                 | 1.8                   | —    | 1.5        | —    | 1                     | —    | ns   |
| tSU          | Set-up Time, data before LE $\downarrow$ , CLK HIGH     | 1.9                   | —    | 1.6        | —    | 1.5                   | —    | ns   |
| tSU          | Set-up Time, data before LE $\downarrow$ , CLK LOW      | 1.3                   | —    | 1.1        | —    | 1                     | —    | ns   |
| tH           | Hold Time, data after CLK $\uparrow$                    | 0.6                   | —    | 0.6        | —    | 0.6                   | —    | ns   |
| tH           | Hold Time, data after LE $\downarrow$ , CLK HIGH or LOW | 1.4                   | —    | 1.7        | —    | 1.4                   | —    | ns   |
| tSK(O)       | Output Skew <sup>(2)</sup>                              | —                     | —    | —          | —    | —                     | 500  | ps   |

### NOTES:

- See TEST CIRCUITS AND WAVEFORMS.  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .
- Skew between any two outputs of the same package and switching in the same direction.

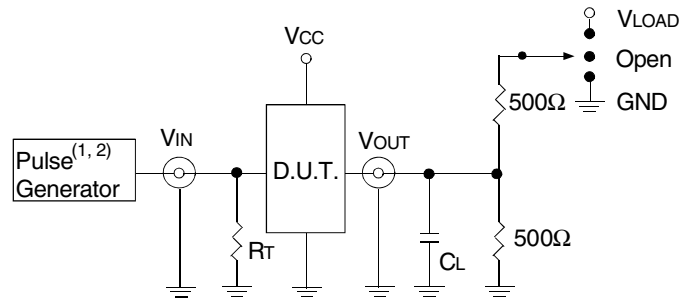
## SWITCHING CHARACTERISTICS FROM $0^\circ\text{C}$ TO $65^\circ\text{C}$ , CL = 50pF

| Symbol       | Parameter                       | Vcc = 3.3V $\pm$ 0.15V |      | Unit |
|--------------|---------------------------------|------------------------|------|------|
|              |                                 | Min.                   | Max. |      |
| tPLH<br>tPHL | Propagation Delay<br>CLK to xYx | 1.8                    | 3.5  | ns   |

## TEST CIRCUITS AND WAVEFORMS

### TEST CONDITIONS

| Symbol            | V <sub>CC</sub> <sup>(1)</sup> =3.3V±0.3V | V <sub>CC</sub> <sup>(1)</sup> =2.7V | V <sub>CC</sub> <sup>(2)</sup> =2.5V±0.2V | Unit |
|-------------------|-------------------------------------------|--------------------------------------|-------------------------------------------|------|
| V <sub>LOAD</sub> | 6                                         | 6                                    | 2 x V <sub>CC</sub>                       | V    |
| V <sub>IH</sub>   | 2.7                                       | 2.7                                  | V <sub>CC</sub>                           | V    |
| V <sub>T</sub>    | 1.5                                       | 1.5                                  | V <sub>CC</sub> / 2                       | V    |
| V <sub>LZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| V <sub>HZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| C <sub>L</sub>    | 50                                        | 50                                   | 30                                        | pF   |



Test Circuit for All Outputs

#### DEFINITIONS:

C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.

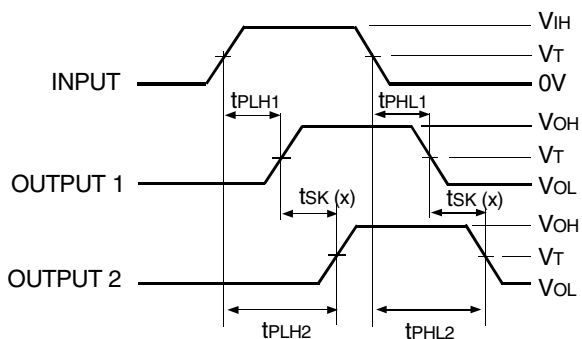
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t<sub>r</sub> ≤ 2.5ns; t<sub>r</sub> ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t<sub>r</sub> ≤ 2ns; t<sub>r</sub> ≤ 2ns.

### SWITCH POSITION

| Test                                    | Switch            |
|-----------------------------------------|-------------------|
| Open Drain<br>Disable Low<br>Enable Low | V <sub>LOAD</sub> |
| Disable High<br>Enable High             | GND               |
| All Other Tests                         | Open              |

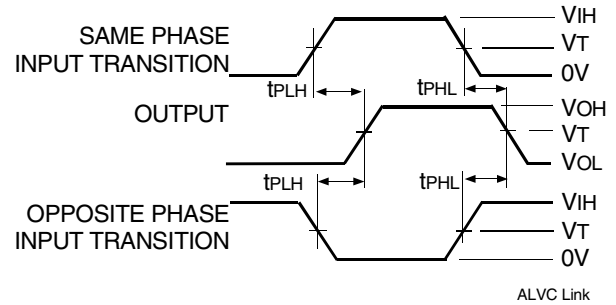


$$t_{sk}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

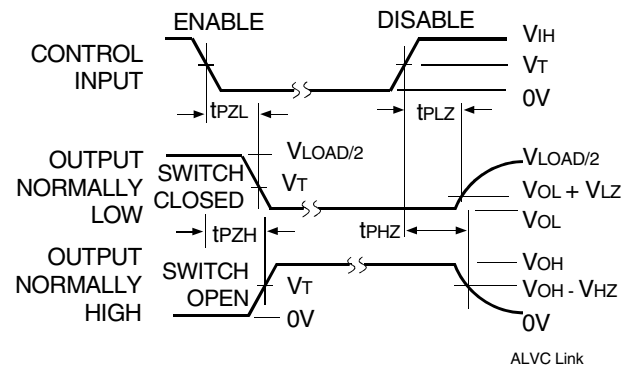
Output Skew - t<sub>sk</sub>(x)

#### NOTES:

1. For t<sub>sk</sub>(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t<sub>sk</sub>(b) OUTPUT1 and OUTPUT2 are in the same bank.



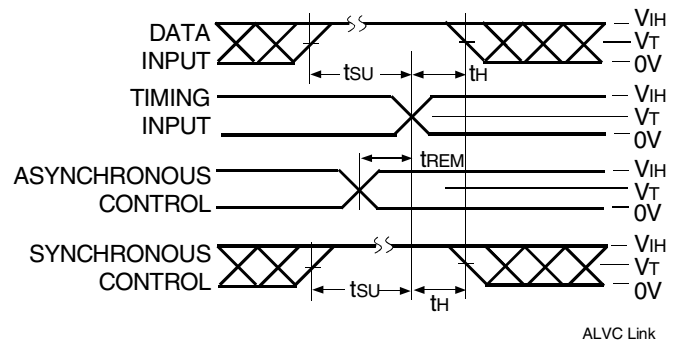
Propagation Delay



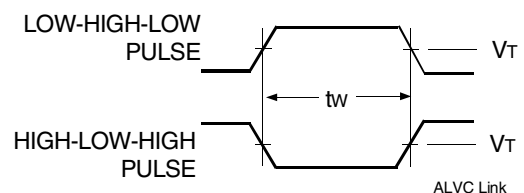
Enable and Disable Times

#### NOTE:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.



Set-up, Hold, and Release Times



Pulse Width

## ORDERING INFORMATION

| <u>XX</u>   | <u>ALVC</u> | <u>X</u> | <u>XXX</u> | <u>XXX</u>  | <u>XX</u> |                                                  |
|-------------|-------------|----------|------------|-------------|-----------|--------------------------------------------------|
| Temp. Range |             | Bus-Hold | Family     | Device Type | Package   |                                                  |
|             |             |          |            |             | PA        | Thin Shrink Small Outline Package                |
|             |             |          |            |             | PAG       | TSSOP - Green                                    |
|             |             |          |            |             | PF        | Thin Very Small Outline Package                  |
|             |             |          |            |             | PFG       | TVSOP - Green                                    |
|             |             |          |            |             |           |                                                  |
|             |             |          |            |             | 835A      | 18-Bit Universal Bus Driver with 3-State Outputs |
|             |             |          |            |             | F162      | Double-Density with Resistors, $\pm 18\text{mA}$ |
|             |             |          |            |             |           |                                                  |
|             |             |          |            |             | Blank     | No Bus-hold                                      |
|             |             |          |            |             | 74        | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$   |



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