

# 54AC16823, 74AC16823 18-BIT BUS INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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- Members of the Texas Instruments *Widebus*™ Family
- Provides Extra Data Width Necessary for Wider Address/Data Paths or Buses With Parity
- Flow-Through Architecture Optimizes PCB Layout
- Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise
- *EPIC*™ (Enhanced-Performance Implanted CMOS) 1- $\mu$ m Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Package Using 25-mil Center-to-Center Pin Spacings and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Pin Spacings

## description

These 18-bit flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing wider buffer registers, I/O ports, parity bus interfacing, and working registers.

The 'AC16823 can be used as two 9-bit flip-flops or one 18-bit flip-flop. With the clock-enable ( $\overline{CLKEN}$ ) input low, the D-type flip-flops enter data on the low-to-high transitions of the clock. Taking  $\overline{CLKEN}$  high disables the clock buffer, thus latching the outputs. Taking the clear ( $\overline{CLR}$ ) input low causes the Q outputs to go low independently of the clock.

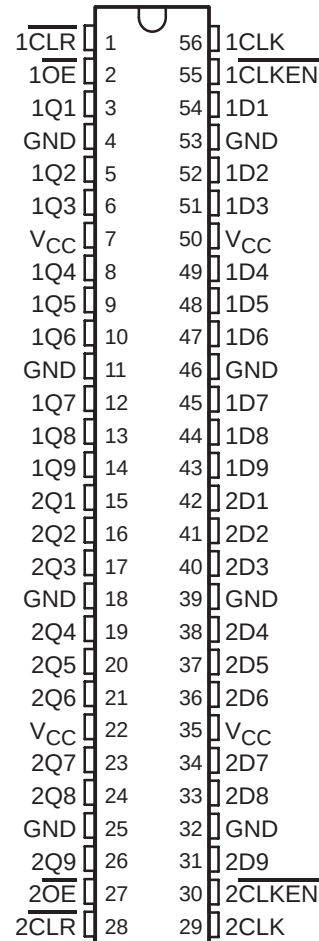
The output enable ( $\overline{OE}$ ) input can be used to place the outputs in either a normal logic state (high or low) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly.

$\overline{OE}$  does not affect the internal operation of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The 74AC16823 is packaged in TI's shrink small-outline package (DL), which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The 54AC16374 is characterized for operation over the full military temperature range of -55°C to 125°C. The 74AC16823 is characterized for operation from -40°C to 85°C.

54AC16823 . . . WD PACKAGE  
74AC16823 . . . DL PACKAGE  
(TOP VIEW)



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**TEXAS  
INSTRUMENTS**

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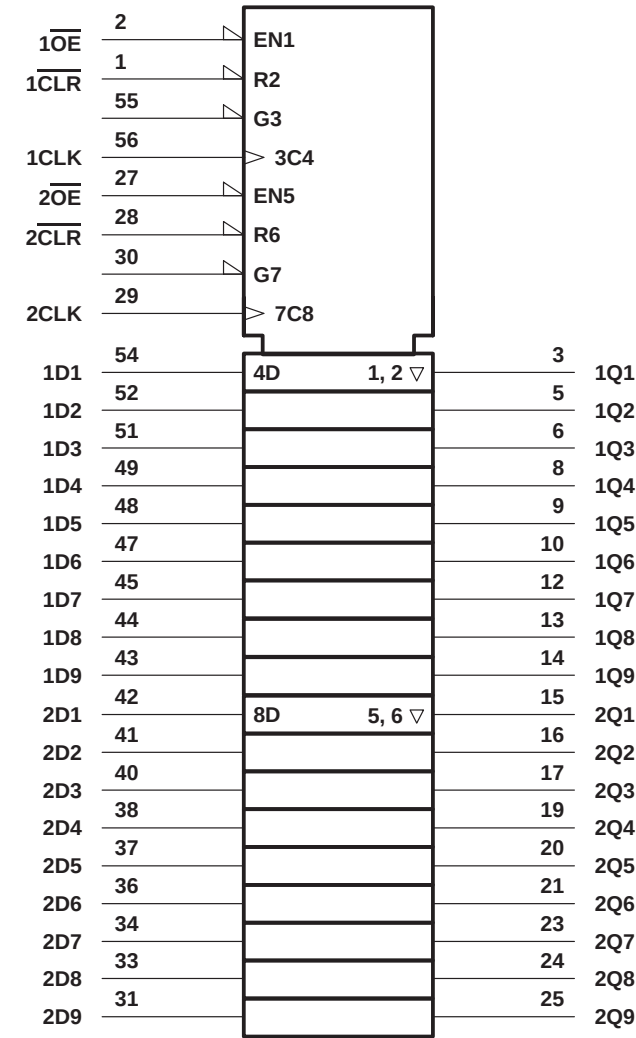
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18-BIT BUS INTERFACE FLIP-FLOPS  
WITH 3-STATE OUTPUTS

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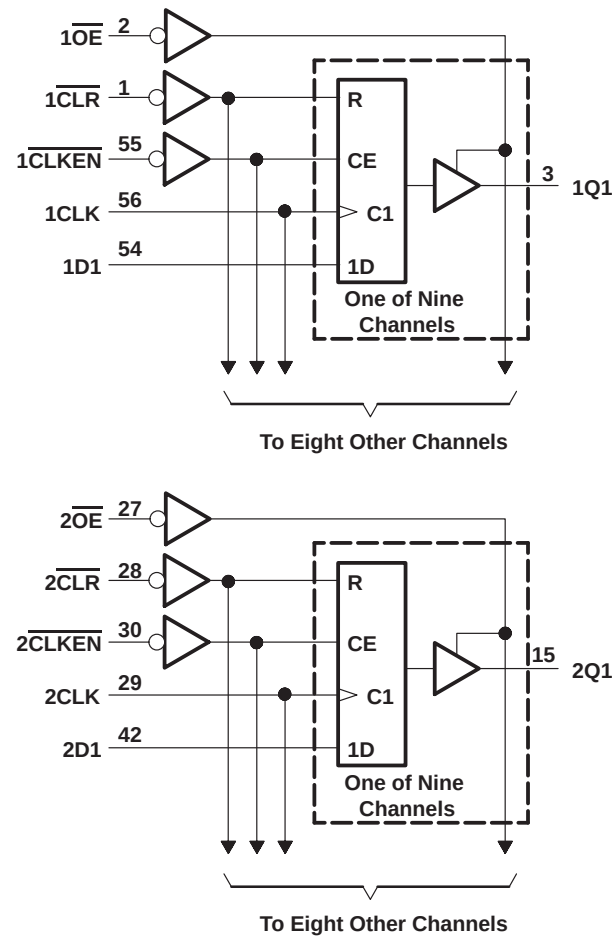
FUNCTION TABLE  
(each 9-bit stage)

| INPUTS          |                  |                    |            |   | OUTPUT<br>Q |
|-----------------|------------------|--------------------|------------|---|-------------|
| $\overline{OE}$ | $\overline{CLR}$ | $\overline{CLKEN}$ | CLK        | D |             |
| L               | L                | X                  | X          | X | L           |
| L               | H                | L                  | $\uparrow$ | H | H           |
| L               | H                | L                  | $\uparrow$ | L | L           |
| L               | H                | L                  | L          | X | $Q_0$       |
| L               | H                | H                  | X          | X | $Q_0$       |
| H               | X                | X                  | X          | X | Z           |

logic symbol†



logic diagram (positive logic)



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

# 54AC16823, 74AC16823 18-BIT BUS INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCAS243A – APRIL 1991 – REVISED APRIL 1996

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|                                                                                                      |                            |
|------------------------------------------------------------------------------------------------------|----------------------------|
| Supply voltage range, $V_{CC}$                                                                       | –0.5 V to 7 V              |
| Input voltage range, $V_I$ (see Note 1)                                                              | –0.5 V to $V_{CC} + 0.5$ V |
| Output voltage range, $V_O$ (see Note 1)                                                             | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )                                        | ±20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )                                       | ±50 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                                           | ±50 mA                     |
| Continuous current through $V_{CC}$ or GND                                                           | ±450 mA                    |
| Maximum power package dissipation at $T_A = 55^\circ\text{C}$ (in still air)(see Note 2): DL package | 1.4 W                      |
| Storage temperature range, $T_{stg}$                                                                 | –65°C to 150°C             |

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

## recommended operating conditions (see Note 3)

|                     |                                    | 54AC16823        |     |          | 74AC16823 |     |          | UNIT |
|---------------------|------------------------------------|------------------|-----|----------|-----------|-----|----------|------|
|                     |                                    | MIN              | NOM | MAX      | MIN       | NOM | MAX      |      |
| $V_{CC}$            | Supply voltage                     | 3                | 5   | 5.5      | 3         | 5   | 5.5      | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 3$ V   |     | 2.1      | 2.1       |     |          | V    |
|                     |                                    | $V_{CC} = 4.5$ V |     | 3.15     | 3.15      |     |          |      |
|                     |                                    | $V_{CC} = 5.5$ V |     | 3.85     | 3.85      |     |          |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 3$ V   |     |          | 0.9       |     | 0.9      | V    |
|                     |                                    | $V_{CC} = 4.5$ V |     |          | 1.35      |     | 1.35     |      |
|                     |                                    | $V_{CC} = 5.5$ V |     |          | 1.65      |     | 1.65     |      |
| $V_I$               | Input voltage                      | 0                |     | $V_{CC}$ | 0         |     | $V_{CC}$ | V    |
| $V_O$               | Output voltage                     | 0                |     | $V_{CC}$ | 0         |     | $V_{CC}$ | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 3$ V   |     | –4       | –4        |     |          | mA   |
|                     |                                    | $V_{CC} = 4.5$ V |     | –24      | –24       |     |          |      |
|                     |                                    | $V_{CC} = 5.5$ V |     | –24      | –24       |     |          |      |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 3$ V   |     | 12       | 12        |     |          | mA   |
|                     |                                    | $V_{CC} = 4.5$ V |     | 24       | 24        |     |          |      |
|                     |                                    | $V_{CC} = 5.5$ V |     | 24       | 24        |     |          |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | 0                |     | 10       | 0         |     | 10       | ns/V |
| $T_A$               | Operating free-air temperature     | –55              |     | 125      | –40       |     | 85       | °C   |

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

# 54AC16823, 74AC16823

## 18-BIT BUS INTERFACE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER       | TEST CONDITIONS                                             | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |      | 54AC16823 |      | 74AC16823 |      | UNIT |
|-----------------|-------------------------------------------------------------|-----------------|-----------------------|-----|------|-----------|------|-----------|------|------|
|                 |                                                             |                 | MIN                   | TYP | MAX  | MIN       | MAX  | MIN       | MAX  |      |
| V <sub>OH</sub> | I <sub>OH</sub> = -50 µA                                    | 3 V             | 2.9                   |     |      | 2.9       |      | 2.9       |      | V    |
|                 |                                                             | 4.5 V           | 4.4                   |     |      | 4.4       |      | 4.4       |      |      |
|                 |                                                             | 5.5 V           | 5.4                   |     |      | 5.4       |      | 5.4       |      |      |
|                 | I <sub>OH</sub> = -4 mA                                     | 3 V             | 2.58                  |     |      | 2.48      |      | 2.48      |      |      |
|                 |                                                             | 4.5 V           | 3.94                  |     |      | 3.8       |      | 3.8       |      |      |
|                 | I <sub>OL</sub> = -24 mA                                    | 5.5 V           | 4.94                  |     |      | 4.8       |      | 4.8       |      |      |
|                 | I <sub>OH</sub> = -75 mA <sup>†</sup>                       | 5.5 V           |                       |     |      | 3.85      |      | 3.85      |      |      |
| V <sub>OL</sub> | I <sub>OL</sub> = 50 µA                                     | 3 V             |                       |     | 0.1  |           | 0.1  |           | 0.1  | V    |
|                 |                                                             | 4.5 V           |                       |     | 0.1  |           | 0.1  |           | 0.1  |      |
|                 |                                                             | 5.5 V           |                       |     | 0.1  |           | 0.1  |           | 0.1  |      |
|                 | I <sub>OL</sub> = 12 mA                                     | 3 V             |                       |     | 0.36 |           | 0.44 |           | 0.44 |      |
|                 |                                                             | 4.5 V           |                       |     | 0.36 |           | 0.44 |           | 0.44 |      |
|                 | I <sub>OL</sub> = 24 mA                                     | 5.5 V           |                       |     | 0.36 |           | 0.44 |           | 0.44 |      |
|                 |                                                             | 5.5 V           |                       |     |      |           | 1.65 |           | 1.65 |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |     | ±0.1 |           | ±1   |           | ±1   | µA   |
| I <sub>OZ</sub> | V <sub>O</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |     | ±0.5 |           | ±5   |           | ±5   | µA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 5.5 V           |                       |     | 8    |           | 80   |           | 80   | µA   |
| C <sub>i</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5 V             |                       |     | 3    |           |      |           |      | pF   |
| C <sub>0</sub>  | V <sub>O</sub> = V <sub>CC</sub> or GND                     | 5 V             |                       |     | 11   |           |      |           |      | pF   |

<sup>†</sup> Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

timing requirements over recommended operating free-air temperature range,  
V<sub>CC</sub> = 3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

|                    |                                    |                   | T <sub>A</sub> = 25°C |     | 54AC16823 |     | 74AC16823 |     | UNIT |
|--------------------|------------------------------------|-------------------|-----------------------|-----|-----------|-----|-----------|-----|------|
|                    |                                    |                   | MIN                   | MAX | MIN       | MAX | MIN       | MAX |      |
| f <sub>clock</sub> | Clock frequency                    |                   | 0                     | 60  | 0         | 60  | 0         | 60  | MHz  |
| t <sub>w</sub>     | Pulse duration                     | CLR low           | 3.3                   |     | 3.3       |     | 3.3       |     | ns   |
|                    |                                    | CLK high or low   | 8.4                   |     | 8.4       |     | 8.4       |     |      |
| t <sub>su</sub>    | Setup time before CLK <sup>↑</sup> | CLR inactive      | 0.5                   |     | 0.5       |     | 0.5       |     | ns   |
|                    |                                    | Data              | 7.2                   |     | 7.2       |     | 7.2       |     |      |
|                    |                                    | CLKEN low         | 5.8                   |     | 5.8       |     | 5.8       |     |      |
| t <sub>h</sub>     | Hold time after CLK <sup>↑</sup>   | Data              | 0                     |     | 0         |     | 0         |     | ns   |
|                    |                                    | CLKEN high or low | 1                     |     | 1         |     | 1         |     |      |

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timing requirements over recommended operating free-air temperature range,  
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

|                    |                                        |                                       | $T_A = 25^\circ\text{C}$ |     | 54AC16823 |     | 74AC16823 |     | UNIT |
|--------------------|----------------------------------------|---------------------------------------|--------------------------|-----|-----------|-----|-----------|-----|------|
|                    |                                        |                                       | MIN                      | MAX | MIN       | MAX | MIN       | MAX |      |
| $f_{\text{clock}}$ | Clock frequency                        |                                       | 0                        | 115 | 0         | 115 | 0         | 115 | MHz  |
| $t_w$              | Pulse duration                         | $\overline{\text{CLR}}$ low           | 3.3                      |     | 3.3       |     | 3.3       |     | ns   |
|                    |                                        | CLK high or low                       | 4.4                      |     | 4.4       |     | 4.4       |     |      |
| $t_{\text{su}}$    | Setup time before $\text{CLK}\uparrow$ | $\overline{\text{CLR}}$ inactive      | 0.6                      |     | 0.6       |     | 0.6       |     | ns   |
|                    |                                        | Data                                  | 5                        |     | 5         |     | 5         |     |      |
|                    |                                        | $\overline{\text{CLKEN}}$ low         | 4.2                      |     | 4.2       |     | 4.2       |     |      |
| $t_h$              | Hold time after $\text{CLK}\uparrow$   | Data                                  | 1.3                      |     | 1.3       |     | 1.3       |     | ns   |
|                    |                                        | $\overline{\text{CLKEN}}$ high or low | 1.4                      |     | 1.4       |     | 1.4       |     |      |

switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM<br>(INPUT)         | TO<br>(OUTPUT) | $T_A = 25^\circ\text{C}$ |      |      | 54AC16823 |      | 74AC16823 |      | UNIT |
|------------------|-------------------------|----------------|--------------------------|------|------|-----------|------|-----------|------|------|
|                  |                         |                | MIN                      | TYP  | MAX  | MIN       | MAX  | MIN       | MAX  |      |
| $f_{\text{max}}$ |                         |                | 60                       |      |      | 60        |      | 60        |      | MHz  |
| $t_{\text{PLH}}$ | CLK                     | Q              | 3.9                      | 13.8 | 16.8 | 3.9       | 18.8 | 3.9       | 18.8 | ns   |
| $t_{\text{PHL}}$ |                         |                | 4.7                      | 14.5 | 17.3 | 4.7       | 18.9 | 4.7       | 18.9 |      |
| $t_{\text{PHL}}$ | $\overline{\text{CLR}}$ | Q              | 4                        | 12.4 | 14.9 | 4         | 16.2 | 4         | 16.2 | ns   |
| $t_{\text{PZH}}$ | $\overline{\text{OE}}$  | Q              | 3                        | 11.1 | 14   | 3         | 15.4 | 3         | 15.4 | ns   |
| $t_{\text{PZL}}$ |                         |                | 4.3                      | 15   | 18.7 | 4.3       | 20.8 | 4.3       | 20.8 |      |
| $t_{\text{PHZ}}$ | $\overline{\text{OE}}$  | Q              | 4.5                      | 8.5  | 10.4 | 4.5       | 11.2 | 4.5       | 11.2 | ns   |
| $t_{\text{PLZ}}$ |                         |                | 3.9                      | 7.7  | 9.3  | 3.9       | 10.3 | 3.9       | 10.3 |      |

switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM<br>(INPUT)         | TO<br>(OUTPUT) | $T_A = 25^\circ\text{C}$ |     |      | 54AC16823 |      | 74AC16823 |      | UNIT |
|------------------|-------------------------|----------------|--------------------------|-----|------|-----------|------|-----------|------|------|
|                  |                         |                | MIN                      | TYP | MAX  | MIN       | MAX  | MIN       | MAX  |      |
| $f_{\text{max}}$ |                         |                | 115                      |     |      | 115       |      | 115       |      | MHz  |
| $t_{\text{PLH}}$ | CLK                     | Q              | 3.1                      | 7.8 | 10.6 | 3.1       | 12   | 3.1       | 12   | ns   |
| $t_{\text{PHL}}$ |                         |                | 3.9                      | 8.6 | 11.4 | 3.9       | 12.7 | 3.9       | 12.7 |      |
| $t_{\text{PHL}}$ | $\overline{\text{CLR}}$ | Q              | 3.2                      | 7.4 | 9.9  | 3.2       | 11   | 3.2       | 11   | ns   |
| $t_{\text{PZH}}$ | $\overline{\text{OE}}$  | Q              | 2.2                      | 6.1 | 8.6  | 2.2       | 9.7  | 2.2       | 9.7  | ns   |
| $t_{\text{PZL}}$ |                         |                | 3                        | 7.4 | 10.6 | 3         | 11.8 | 3         | 11.8 |      |
| $t_{\text{PHZ}}$ | $\overline{\text{OE}}$  | Q              | 4.2                      | 6.8 | 8.7  | 4.2       | 9.3  | 4.2       | 9.3  | ns   |
| $t_{\text{PLZ}}$ |                         |                | 3.7                      | 6.2 | 7.8  | 3.7       | 8.6  | 3.7       | 8.6  |      |

operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER       |                                             | TEST CONDITIONS  |                                           | TYP | UNIT |
|-----------------|---------------------------------------------|------------------|-------------------------------------------|-----|------|
| $C_{\text{pd}}$ | Power dissipation capacitance per flip-flop | Outputs enabled  | $C_L = 50\text{ pF}$ , $f = 1\text{ MHz}$ | 36  | pF   |
|                 |                                             | Outputs disabled |                                           | 18  |      |

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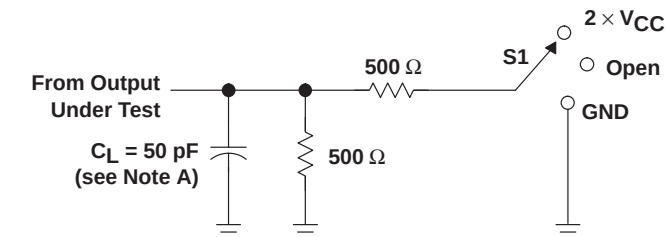
# 54AC16823, 74AC16823

## 18-BIT BUS INTERFACE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

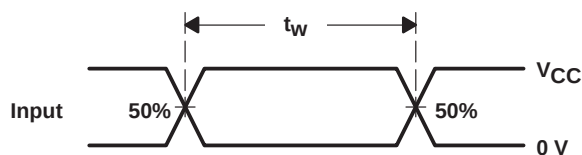
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#### PARAMETER MEASUREMENT INFORMATION

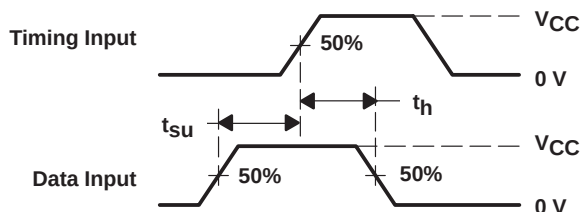


LOAD CIRCUIT

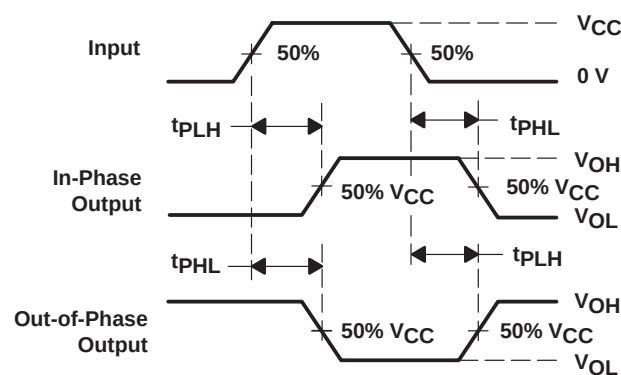
| TEST              | S1                |
|-------------------|-------------------|
| $t_{PLH}/t_{PHL}$ | Open              |
| $t_{PLZ}/t_{PZL}$ | 2 $\times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |



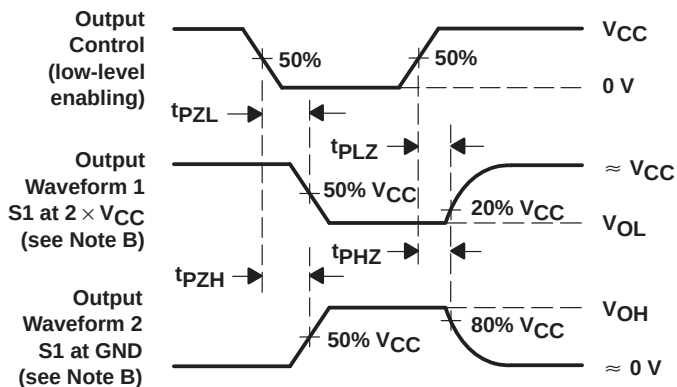
VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



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:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 3 \text{ ns}$ ,  $t_f = 3 \text{ ns}$ .
  - The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

## PACKAGING INFORMATION

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 74AC16823DL      | OBSOLETE              | SSOP         | DL              | 56   |             | TBD                     | Call TI          | Call TI                      |
| 74AC16823DLR     | OBSOLETE              | SSOP         | DL              | 56   |             | TBD                     | Call TI          | Call TI                      |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

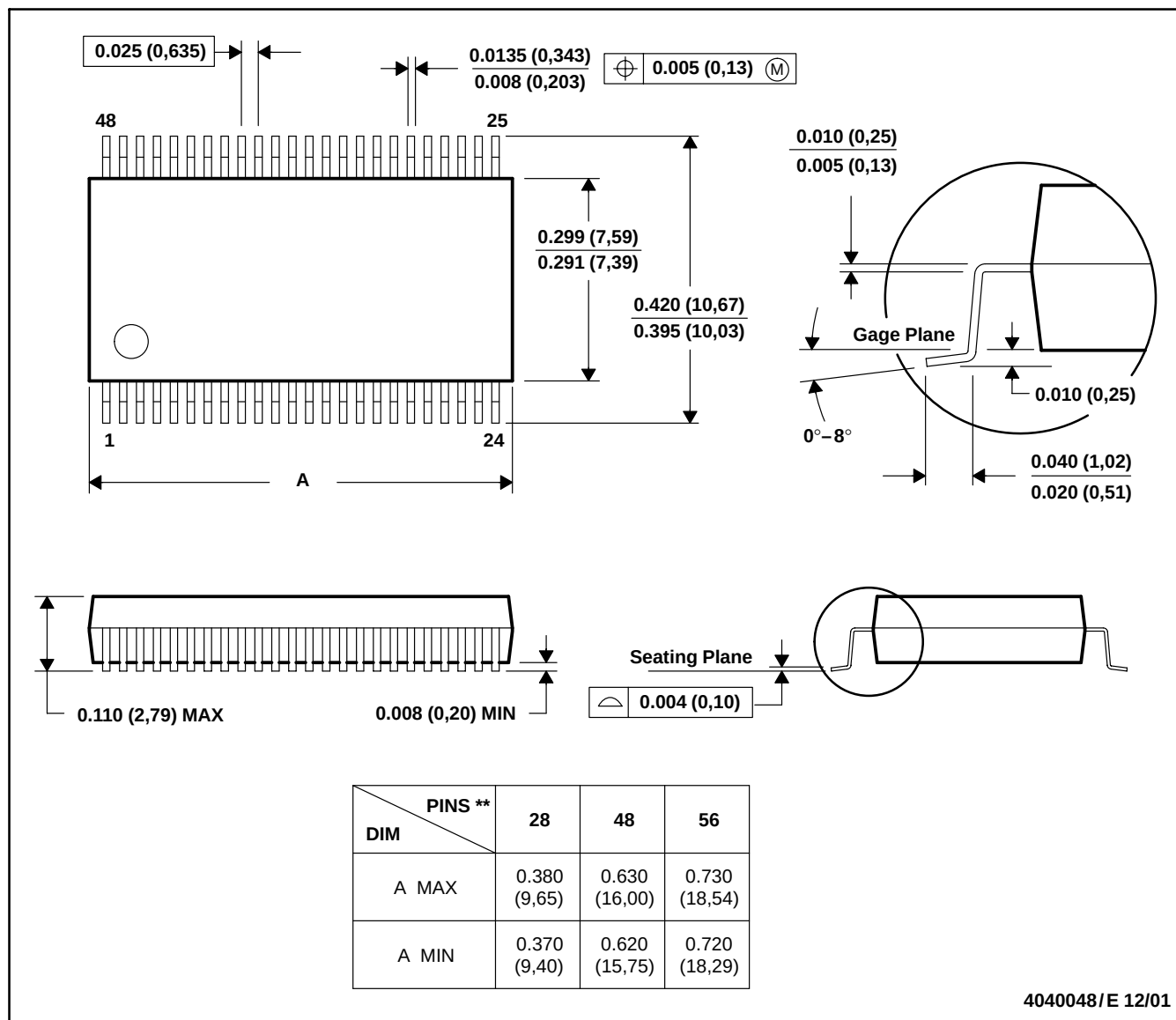
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DL (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
 D. Falls within JEDEC MO-118



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