

# SN54AS823A, SN74AS823A, SN74AS824A 9-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

SDAS231A – JUNE 1984 – REVISED AUGUST 1995

- Functionally Equivalent to AMD's AM29823 and AM29824
- Provide Extra Data Width Necessary for Wider Address/Data Paths or Buses With Parity
- Outputs Have Undershoot-Protection Circuitry
- Power-Up High-Impedance State
- Buffered Control Inputs to Reduce dc Loading Effects
- Package Options Include Plastic Small-Outline (DW) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (NT) and Ceramic (JT) 300-mil DIPs

## description

These 9-bit flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. These devices are particularly suitable for implementing wider buffer registers, I/O ports, bidirectional bus drivers, parity bus interfacing, and working registers.

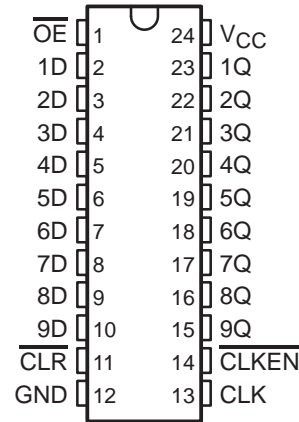
With the clock-enable ( $\overline{\text{CLKEN}}$ ) input low, the nine D-type edge-triggered flip-flops enter data on the low-to-high transitions of the clock (CLK) input. Taking  $\overline{\text{CLKEN}}$  high disables the clock buffer, latching the outputs. The SN54AS823A and SN74AS823A have noninverting data (D) inputs and the SN74AS824A has inverting ( $\overline{\text{D}}$ ) inputs. Taking the clear ( $\overline{\text{CLR}}$ ) input low causes the nine Q outputs to go low independently of the clock.

A buffered output-enable ( $\overline{\text{OE}}$ ) input can be used to place the nine outputs in either a normal logic state (high or low logic level) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without interface or pullup components.

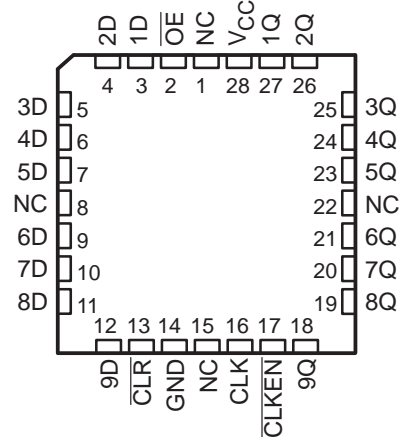
$\overline{\text{OE}}$  does not affect the internal operation of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The SN54AS823A is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74AS823A and SN74AS824A are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

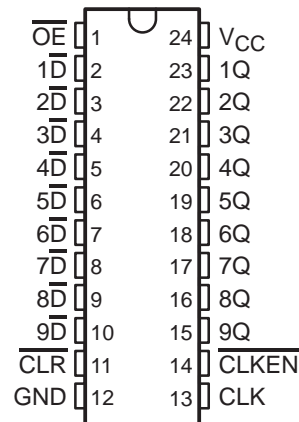
SN54AS823A . . . JT PACKAGE  
SN74AS823A . . . DW OR NT PACKAGE  
(TOP VIEW)



SN54AS823A . . . FK PACKAGE  
(TOP VIEW)



SN74AS824A . . . DW OR NT PACKAGE  
(TOP VIEW)



NC – No internal connection

# SN54AS823A, SN74AS823A, SN74AS824A 9-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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## Function Tables

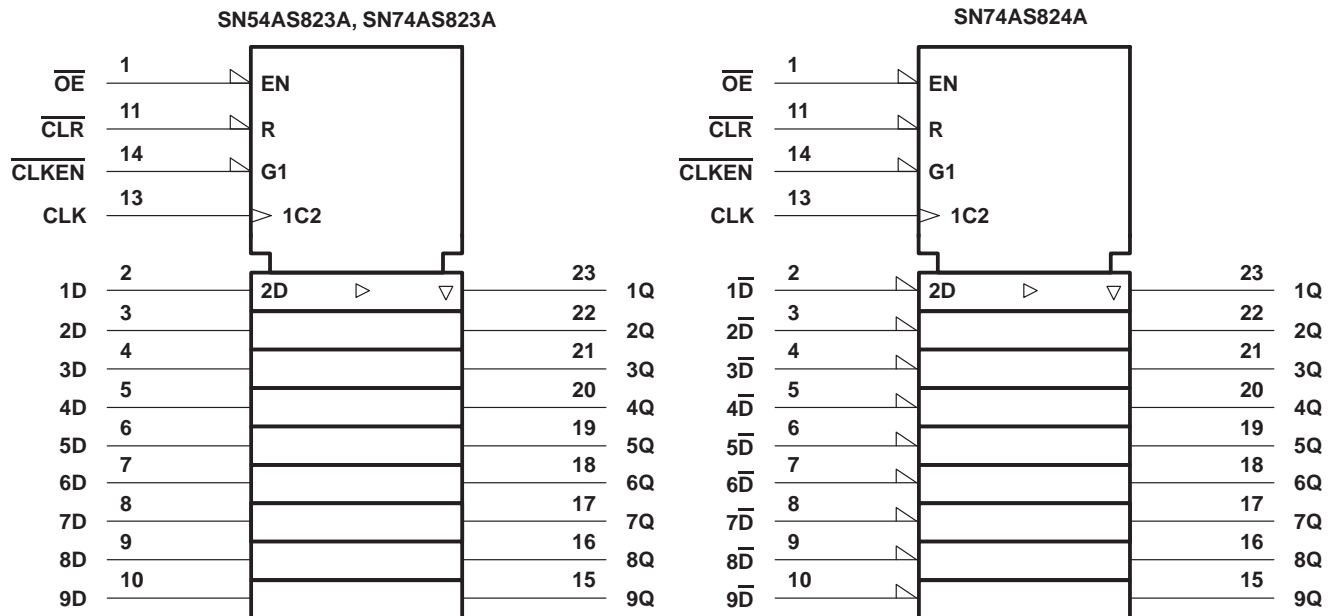
SN54AS823A, SN74AS823A  
(each flip-flop)

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

SN74AS824A  
(each flip-flop)

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

## logic symbol†

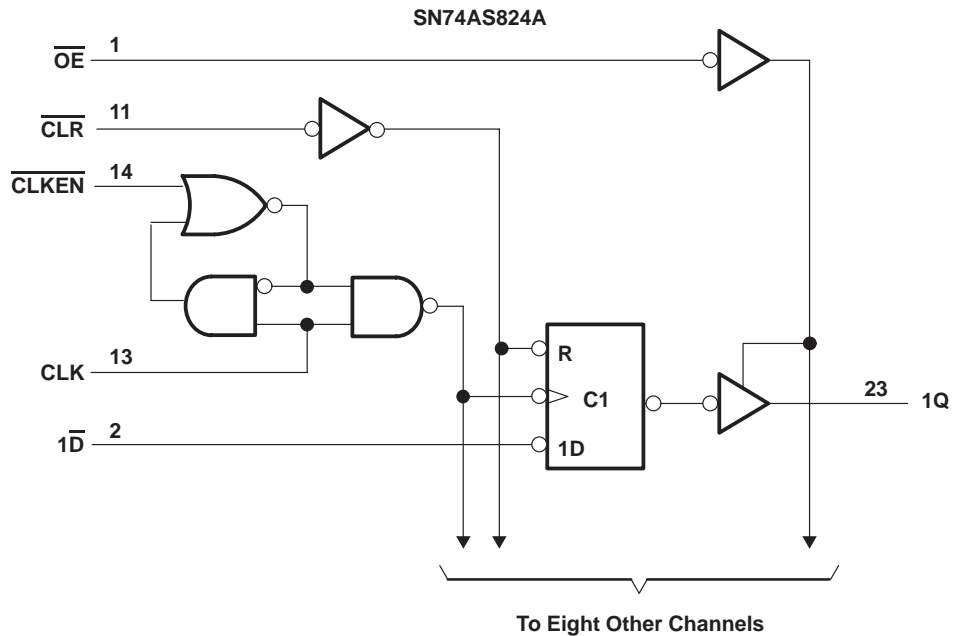
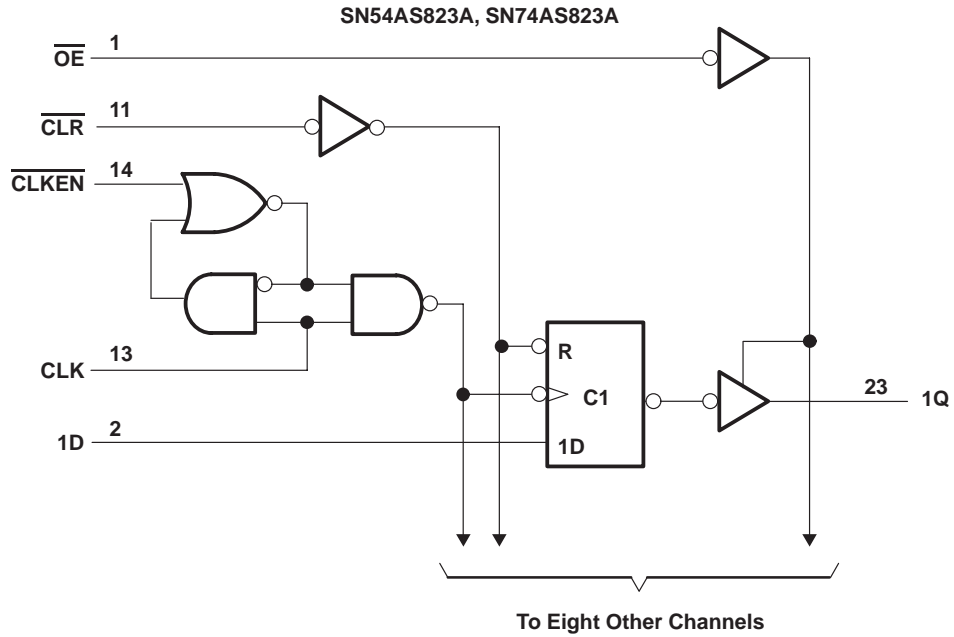


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the DW, JT, and NT packages.

SN54AS823A, SN74AS823A, SN74AS824A  
 9-BIT BUS-INTERFACE FLIP-FLOPS  
 WITH 3-STATE OUTPUTS

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logic diagrams (positive logic)



Pin numbers shown are for the DW, JT, and NT packages.

# SN54AS823A, SN74AS823A, SN74AS824A 9-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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

|                                                          |                |
|----------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                                 | 7 V            |
| Input voltage, $V_I$                                     | 7 V            |
| Voltage applied to a disabled 3-state output             | 5.5 V          |
| Operating free-air temperature range, $T_A$ : SN54AS823A | –55°C to 125°C |
| SN74AS823A, SN74AS824A                                   | 0°C to 70°C    |
| Storage temperature range                                | –65°C to 150°C |

† 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.

## recommended operating conditions

|            |                                | SN54AS823A        |     |     | SN74AS823A<br>SN74AS824A |     |     | UNIT |
|------------|--------------------------------|-------------------|-----|-----|--------------------------|-----|-----|------|
|            |                                | MIN               | NOM | MAX | MIN                      | NOM | MAX |      |
| $V_{CC}$   | Supply voltage                 | 4.5               | 5   | 5.5 | 4.5                      | 5   | 5.5 | V    |
| $V_{IH}$   | High-level input voltage       | 2                 |     |     | 2                        |     |     | V    |
| $V_{IL}$   | Low-level input voltage        |                   |     | 0.8 |                          |     | 0.8 | V    |
| $I_{OH}$   | High-level output current      |                   |     | –24 |                          |     | –24 | mA   |
| $I_{OL}$   | Low-level output current       |                   |     | 32  |                          |     | 48  | mA   |
| $t_w^*$    | Pulse duration                 | CLR low           | 7.5 |     | 6.5                      |     |     | ns   |
|            |                                | CLK high or low   | 9.5 |     | 8                        |     |     |      |
| $t_{su}^*$ | Setup time before CLK↑         | CLR high          | 8   |     | 8                        |     |     | ns   |
|            |                                | Data              | 7   |     | 6                        |     |     |      |
|            |                                | CLKEN high or low | 8.5 |     | 7.5                      |     |     |      |
| $t_h^*$    | Hold time after CLK↑           |                   |     | 0   |                          |     | 0   | ns   |
| $T_A$      | Operating free-air temperature | –55               |     | 125 | 0                        |     | 70  | °C   |

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.

# SN54AS823A, SN74AS823A, SN74AS824A 9-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                                                   |                          | SN54AS823A       |      |      | SN74AS823A<br>SN74AS824A |      |      | UNIT          |
|-----------------|-------------------------------------------------------------------|--------------------------|------------------|------|------|--------------------------|------|------|---------------|
|                 |                                                                   |                          | MIN              | TYP† | MAX  | MIN                      | TYP† | MAX  |               |
| $V_{IK}$        | $V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$                   |                          | -1.2             |      |      | -1.2                     |      |      | V             |
| $V_{OH}$        | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ , $I_{OH} = -2\text{ mA}$ |                          | $V_{CC} - 2$     |      |      | $V_{CC} - 2$             |      |      | V             |
|                 | $V_{CC} = 4.5\text{ V}$                                           | $I_{OH} = -15\text{ mA}$ | 2.4              | 3.2  |      | 2.4                      | 3.2  |      |               |
|                 |                                                                   | $I_{OH} = -24\text{ mA}$ | 2                |      |      | 2                        |      |      |               |
| $V_{OL}$        | $V_{CC} = 4.5\text{ V}$                                           | $I_{OL} = 32\text{ mA}$  | 0.3 0.5          |      |      |                          |      | V    |               |
|                 |                                                                   | $I_{OL} = 48\text{ mA}$  |                  |      |      | 0.35                     | 0.5  |      |               |
| $I_{OZH}$       | $V_{CC} = 5.5\text{ V}$ ,                                         | $V_O = 2.7\text{ V}$     | 50               |      |      | 50                       |      |      | $\mu\text{A}$ |
| $I_{OZL}$       | $V_{CC} = 5.5\text{ V}$ ,                                         | $V_I = 0.4\text{ V}$     | -50              |      |      | -50                      |      |      | $\mu\text{A}$ |
| $I_I$           | $V_{CC} = 5.5\text{ V}$ ,                                         | $V_I = 7\text{ V}$       | 0.1              |      |      | 0.1                      |      |      | mA            |
| $I_{IH}$        | $V_{CC} = 5.5\text{ V}$ ,                                         | $V_I = 2.7\text{ V}$     | 20               |      |      | 20                       |      |      | $\mu\text{A}$ |
| $I_{IL}$        | $V_{CC} = 5.5\text{ V}$ ,                                         | $V_I = 0.4\text{ V}$     | -0.5             |      |      | -0.5                     |      |      | mA            |
| $I_{O\ddagger}$ | $V_{CC} = 5.5\text{ V}$ ,                                         | $V_O = 2.25\text{ V}$    | -30              |      | -112 | -30                      |      | -112 | mA            |
| $I_{CC}$        | SN54AS823A,<br>SN74AS823A                                         | $V_{CC} = 5.5\text{ V}$  | Outputs high     | 49   | 80   | 49                       | 80   | mA   |               |
|                 |                                                                   |                          | Outputs low      | 61   | 100  | 61                       | 100  |      |               |
|                 |                                                                   |                          | Outputs disabled | 64   | 103  | 64                       | 103  |      |               |
|                 | SN74AS824A                                                        | $V_{CC} = 5.5\text{ V}$  | Outputs high     | 49   | 80   | 49                       | 80   |      |               |
|                 |                                                                   |                          | Outputs low      | 61   | 100  | 61                       | 100  |      |               |
|                 |                                                                   |                          | Outputs disabled | 64   | 103  | 64                       | 103  |      |               |

† All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

## switching characteristics (see Figure 1)

| PARAMETER | FROM<br>(INPUT)         | TO<br>(OUTPUT) | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ,<br>$C_L = 50\text{ pF}$ ,<br>$R_1 = 500\ \Omega$ ,<br>$R_2 = 500\ \Omega$ ,<br>$T_A = \text{MIN to MAX}\S$ |      |                          |      | UNIT |
|-----------|-------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------|------|------|
|           |                         |                | SN54AS823A                                                                                                                                           |      | SN74AS823A<br>SN74AS824A |      |      |
|           |                         |                | MIN                                                                                                                                                  | MAX  | MIN                      | MAX  |      |
| $t_{PLH}$ | CLK                     | Any Q          | 3.5                                                                                                                                                  | 9    | 3.5                      | 7.5  | ns   |
| $t_{PHL}$ |                         |                | 3.5                                                                                                                                                  | 14   | 3.5                      | 13   |      |
| $t_{PHL}$ | $\overline{\text{CLR}}$ | Any Q          | 3.5                                                                                                                                                  | 16.5 | 3.5                      | 15.5 | ns   |
| $t_{PZH}$ | $\overline{\text{OE}}$  | Any Q          | 4                                                                                                                                                    | 12   | 4                        | 11   | ns   |
| $t_{PZL}$ |                         |                | 4                                                                                                                                                    | 13   | 4                        | 12   |      |
| $t_{PHZ}$ | $\overline{\text{OE}}$  | Any Q          | 1                                                                                                                                                    | 10   | 1                        | 8    | ns   |
| $t_{PLZ}$ |                         |                | 1                                                                                                                                                    | 10   | 1.5                      | 8    |      |

§ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

# SN54AS823A, SN74AS823A, SN74AS824A 9-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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## PARAMETER MEASUREMENT INFORMATION SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. 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.  
 C. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
 D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
 E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-89525013A   | ACTIVE                | LCCC         | FK              | 28   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| 5962-8952501KA   | ACTIVE                | CFP          | W               | 24   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| 5962-8952501LA   | ACTIVE                | CDIP         | JT              | 24   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| SN74AS823ADW     | NRND                  | SOIC         | DW              | 24   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS823ADWE4   | NRND                  | SOIC         | DW              | 24   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS823ADWG4   | NRND                  | SOIC         | DW              | 24   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS823ANT     | NRND                  | PDIP         | NT              | 24   | 15          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74AS823ANTE4   | NRND                  | PDIP         | NT              | 24   | 15          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74AS824ADW     | OBSOLETE              | SOIC         | DW              | 24   |             | TBD                     | Call TI          | Call TI                      |
| SN74AS824ADWR    | OBSOLETE              | SOIC         | DW              | 24   |             | TBD                     | Call TI          | Call TI                      |
| SN74AS824ANT     | OBSOLETE              | PDIP         | NT              | 24   |             | TBD                     | Call TI          | Call TI                      |
| SNJ54AS823AFK    | ACTIVE                | LCCC         | FK              | 28   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| SNJ54AS823AJT    | ACTIVE                | CDIP         | JT              | 24   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| SNJ54AS823AW     | ACTIVE                | CFP          | W               | 24   | 1           | TBD                     | A42              | N / A for Pkg Type           |

<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), Pb-Free (RoHS Exempt), 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.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**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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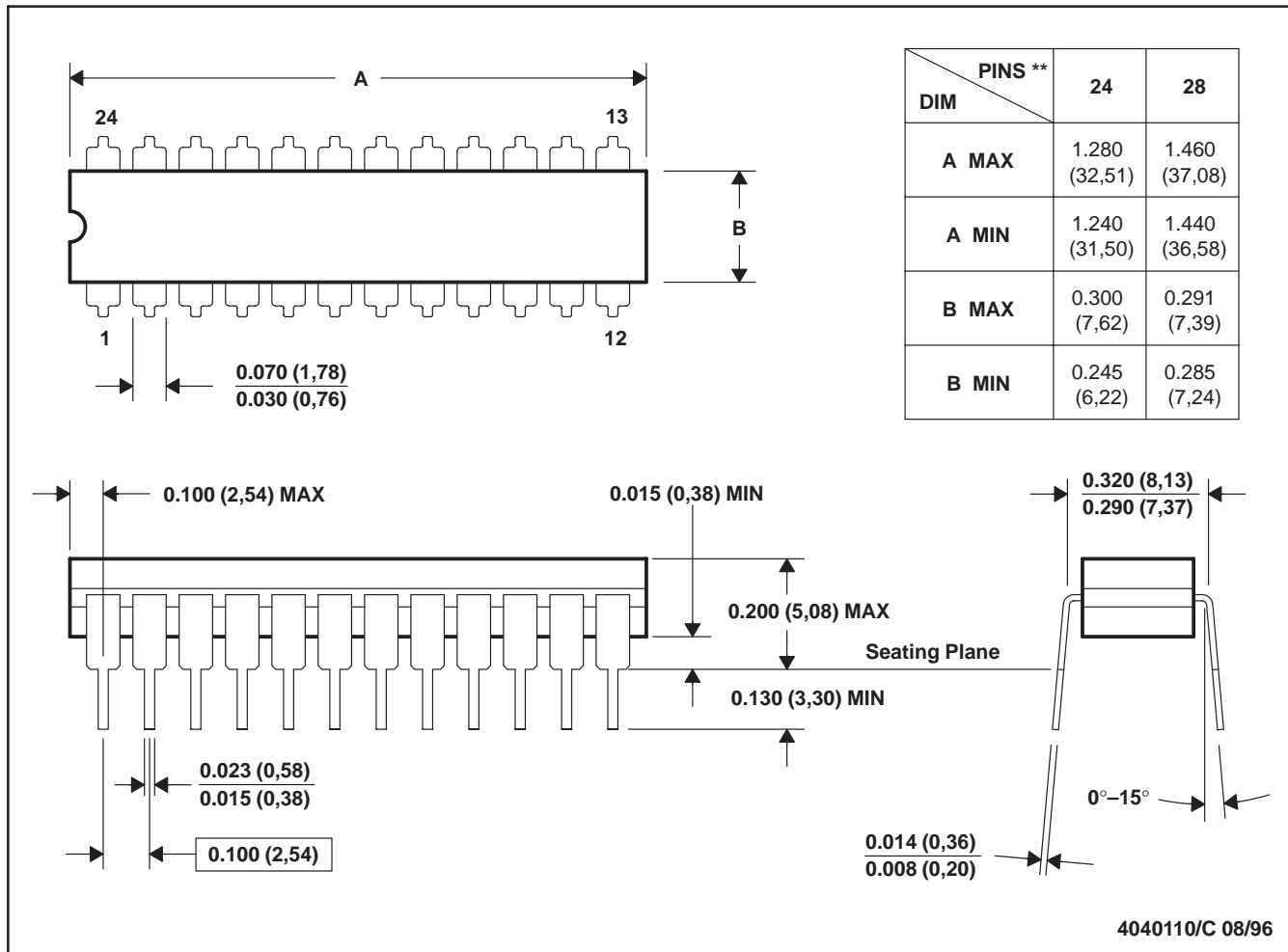
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JT (R-GDIP-T\*\*)

CERAMIC DUAL-IN-LINE

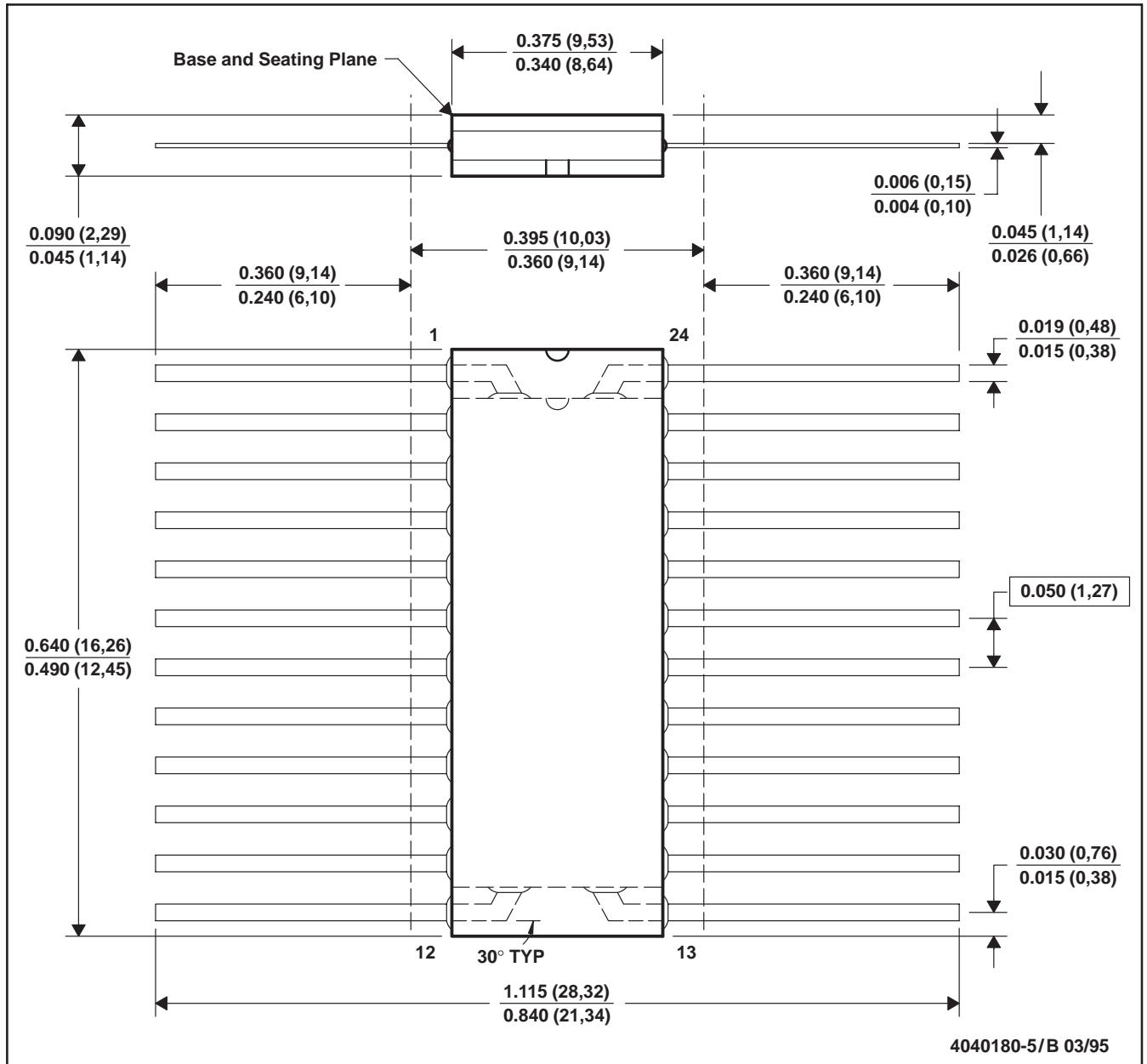
24 LEADS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification.  
 E. Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

W (R-GDFP-F24)

CERAMIC DUAL FLATPACK

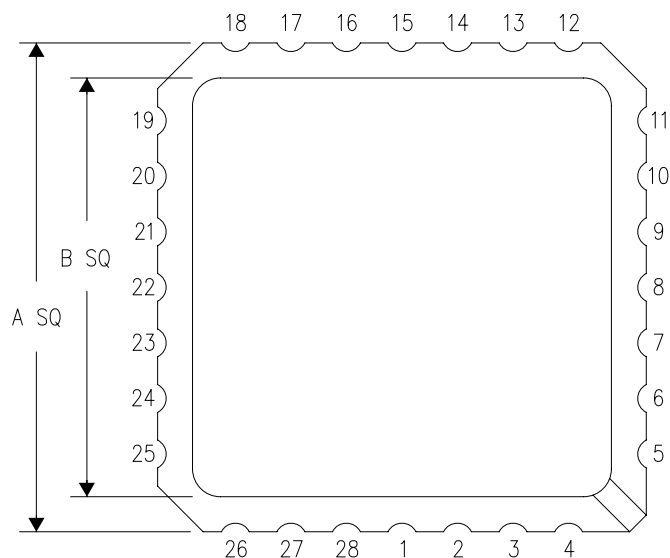


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Falls within MIL-STD-1835 GDFP2-F24 and JEDEC MO-070AD
  - Index point is provided on cap for terminal identification only.

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF TERMINALS ** | A                |                  | B                |                  |
|---------------------|------------------|------------------|------------------|------------------|
|                     | MIN              | MAX              | MIN              | MAX              |
| 20                  | 0.342<br>(8,69)  | 0.358<br>(9,09)  | 0.307<br>(7,80)  | 0.358<br>(9,09)  |
| 28                  | 0.442<br>(11,23) | 0.458<br>(11,63) | 0.406<br>(10,31) | 0.458<br>(11,63) |
| 44                  | 0.640<br>(16,26) | 0.660<br>(16,76) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 52                  | 0.740<br>(18,78) | 0.761<br>(19,32) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 68                  | 0.938<br>(23,83) | 0.962<br>(24,43) | 0.850<br>(21,6)  | 0.858<br>(21,8)  |
| 84                  | 1.141<br>(28,99) | 1.165<br>(29,59) | 1.047<br>(26,6)  | 1.063<br>(27,0)  |



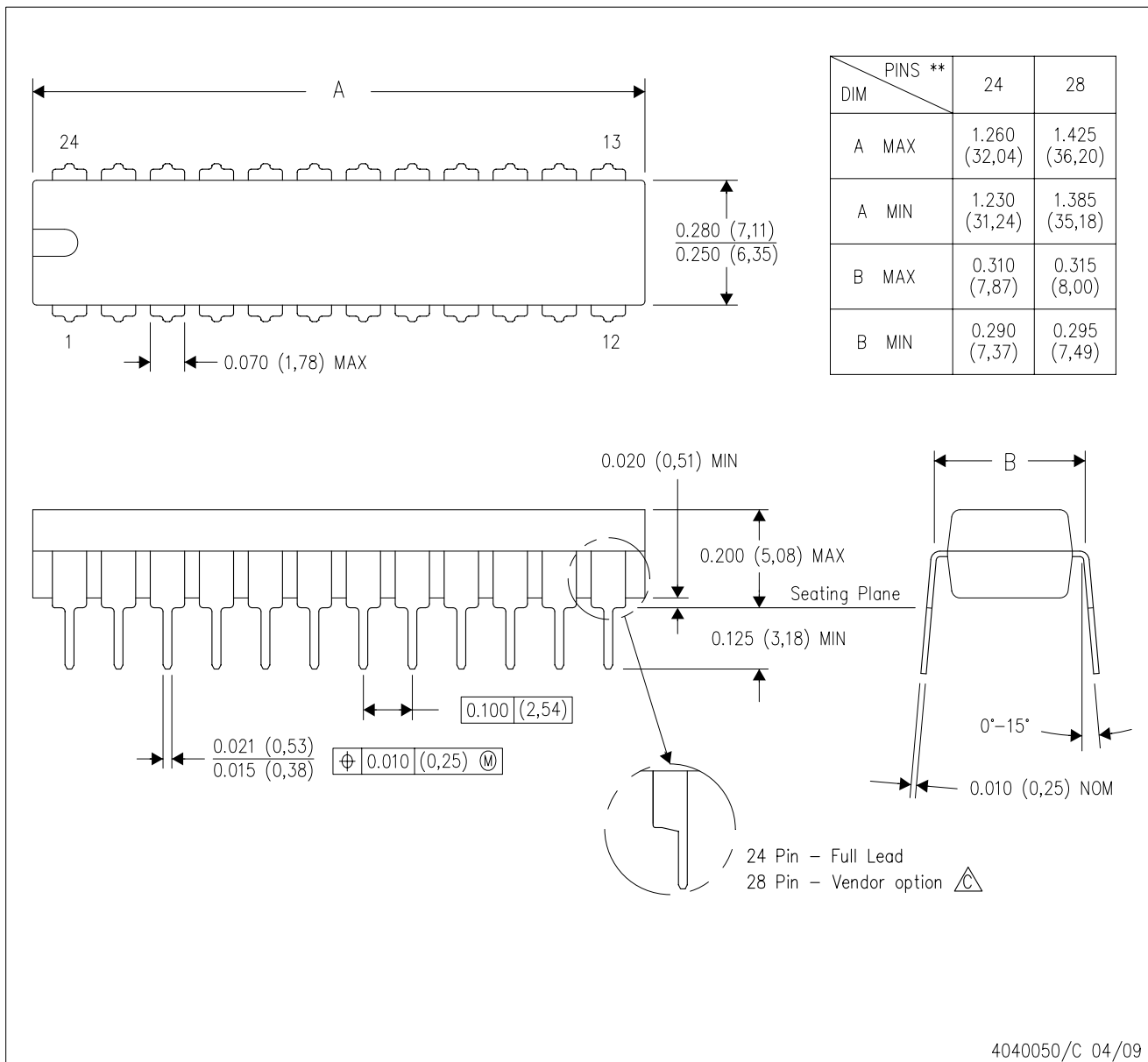
4040140/D 01/11


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

# MECHANICAL DATA

NT (R-PDIP-T\*\*) 24 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  -  The 28 pin end lead shoulder width is a vendor option, either half or full width.

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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 MS-013 variation AD.

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|                               |                                                                                          |
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