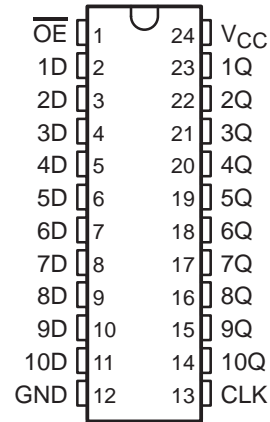


# SN54ABT821, SN74ABT821 10-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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- State-of-the-Art *EPIC-II B*™ BiCMOS Design Significantly Reduces Power Dissipation
- ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Typical  $V_{OLP}$  (Output Ground Bounce)  $< 1$  V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- High-Drive Outputs ( $-32\text{-mA } I_{OH}$ ,  $64\text{-mA } I_{OL}$ )
- Package Options Include Plastic Small-Outline (DW) and Shrink Small-Outline (DB) Packages, Ceramic Chip Carriers (FK), and Plastic (NT) and Ceramic (JT) DIPs

SN54ABT821 . . . JT PACKAGE  
SN74ABT821 . . . DB, DW, OR NT PACKAGE  
(TOP VIEW)



## description

These 10-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, bidirectional bus drivers with parity, and working registers.

The ten flip-flops are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the device provides true data at the Q outputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the ten outputs in either a normal logic state (high or low level) or a 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 need for interface or pullup components.

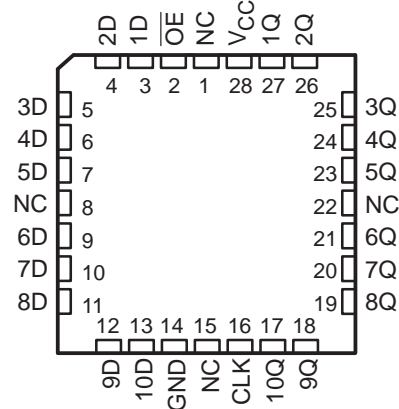
$\overline{OE}$  does not affect the internal operations of the latch. Previously stored data can be retained or new data can be entered while the outputs are in the high-impedance state.

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.

The SN74ABT821 is available in TI's shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54ABT821 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT821 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54ABT821 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

EPIC-II B is a trademark of Texas Instruments Incorporated.

UNLESS OTHERWISE NOTED this document contains PRODUCTION DATA information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

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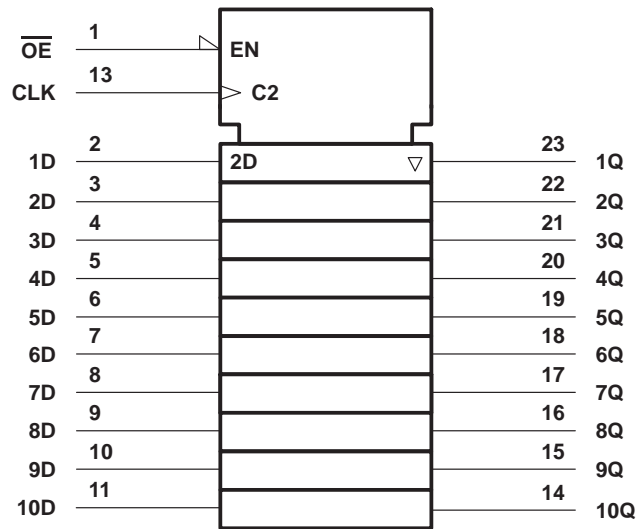
# SN54ABT821, SN74ABT821 10-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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FUNCTION TABLE  
(each flip-flop)

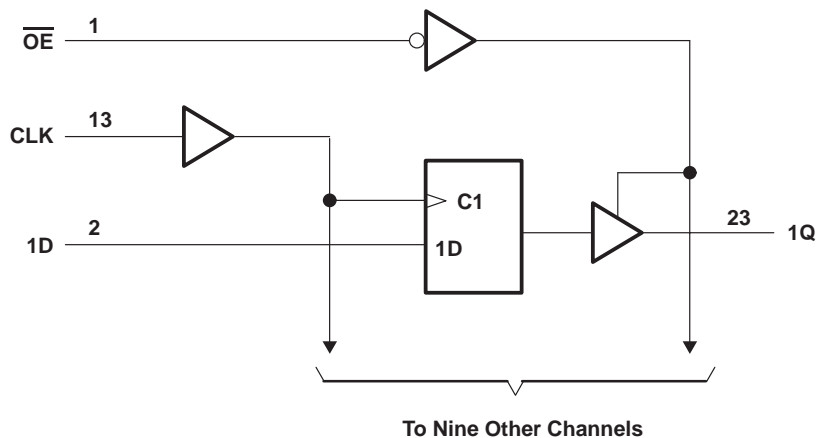
INPUTS			OUTPUT
$\overline{OE}$	CLK	D	Q
L	↑	H	H
L	↑	L	L
L	H or L	X	$Q_0$
H	X	X	Z

## logic symbol†



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

## logic diagram (positive logic)



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

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

Supply voltage range, $V_{CC}$ .....	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) .....	–0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, $V_O$ .....	–0.5 V to 5.5 V
Current into any output in the low state, $I_O$ : SN54ABT821 .....	96 mA
SN74ABT821 .....	128 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	–18 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	–50 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DB package .....	0.65 W
DW package .....	1.7 W
NT package .....	1.3 W
Storage temperature range .....	–65°C to 150°C

† Stresses beyond 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 beyond those indicated in the “recommended operating conditions” section of this specification is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-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, except for the NT package, which has a trace length of zero. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

## recommended operating conditions (see Note 3)

		SN54ABT821		SN74ABT821		UNIT
		MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	4.5	5.5	4.5	5.5	V
$V_{IH}$	High-level input voltage	2		2		V
$V_{IL}$	Low-level input voltage		0.8		0.8	V
$V_I$	Input voltage	0	$V_{CC}$	0	$V_{CC}$	V
$I_{OH}$	High-level output current		–24		–32	mA
$I_{OL}$	Low-level output current		48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate		10		10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200		200		$\mu\text{s}/\text{V}$
$T_A$	Operating free-air temperature	–55	125	–40	85	°C

NOTE 3: Unused or floating inputs must be held high or low.

# SN54ABT821, SN74ABT821 10-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	T <sub>A</sub> = 25°C			SN54ABT821		SN74ABT821		UNIT
		MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA			-1.2		-1.2		-1.2	V
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -3 mA			2.5		2.5		2.5	V
	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = -3 mA			3		3		3	
	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -24 mA I <sub>OH</sub> = -32 mA			2 2*		2		2	
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 48 mA I <sub>OL</sub> = 64 mA					0.55		0.55	V
						0.55*		0.55	
I <sub>I</sub>	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND			±1		±1		±1	μA
I <sub>OZPU</sub>	V <sub>CC</sub> = 0 to 2.1 V, V <sub>O</sub> = 0.5 to 2.7 V, $\overline{OE} = X$			±50		±50		±50	μA
I <sub>OZPD</sub>	V <sub>CC</sub> = 2.1 V to 0, V <sub>O</sub> = 0.5 to 2.7 V, $\overline{OE} = X$			±50		±50		±50	μA
I <sub>OZH</sub>	V <sub>CC</sub> = 2.1 V to 5.5 V, V <sub>O</sub> = 2.7 V, $\overline{OE} \geq 2 V$			10		10		10	μA
I <sub>OZL</sub>	V <sub>CC</sub> = 2.1 V to 5.5 V, V <sub>O</sub> = 0.5 V, $\overline{OE} \geq 2 V$			-10		-10		-10	μA
I <sub>off</sub>	V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V			±100				±100	μA
I <sub>CEX</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V, Outputs high			50		50		50	μA
I <sub>O‡</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V	-50	-140	-180	-50	-180	-50	-180	mA
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0,	Outputs high		1	250	250	250	250	μA
		Outputs low		24	38	38	38	38	mA
		Outputs disabled		0.5	250	250	250	250	μA
ΔI <sub>CC</sub> §	V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND			1.5		1.5		1.5	mA
C <sub>i</sub>	V <sub>I</sub> = 2.5 V or 0.5 V			4					pF
C <sub>o</sub>	V <sub>O</sub> = 2.5 V or 0.5 V			7					pF

\* On products compliant to MIL-STD-883, Class B, this parameter does not apply.

† All typical values are at V<sub>CC</sub> = 5 V.

‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V<sub>CC</sub> or GND.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

		V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C		SN54ABT821		SN74ABT821		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	0	125	0	125	0	125	MHz
t <sub>w</sub>	Pulse duration, CLK high or low	High	2.9	2.9	2.9	2.9	2.9	ns
		Low	3.8	3.8	3.8	3.8		
t <sub>su</sub>	Setup time, data before CLK↑	2.1	2.1	2.1	2.1	2.1	2.1	ns
t <sub>h</sub>	Hold time, data after CLK↑	1.3	1.3	1.3	1.3	1.3	1.3	ns

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**SN54ABT821, SN74ABT821**  
**10-BIT BUS-INTERFACE FLIP-FLOPS**  
**WITH 3-STATE OUTPUTS**

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switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

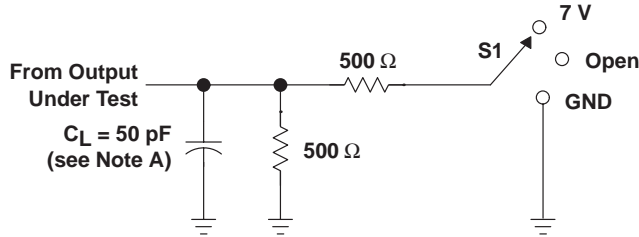
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 5$ V, $T_A = 25^\circ$ C			SN54ABT821		SN74ABT821		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{max}$			125			125		125		MHz
$t_{PLH}$	CLK	Q	1.6†	4.1	5.6	1.6†	6.9	1.6†	6.2	ns
$t_{PHL}$			2.1†	4.6	6.2	2.1†	6.9	2.1†	6.7	
$t_{PZH}$	$\overline{OE}$	Q	1	3	4.5	1	6	1	5.3	ns
$t_{PZL}$			2.2	4.1	5.6	2.2	6.5	2.2	6.3	
$t_{PHZ}$	OE	Q	2.7	4.7	6.2	2.7	7	2.7	6.7	ns
$t_{PLZ}$			1.7†	4.6	6.1	1.7†	7	1.7†	6.5	

† This data sheet limit may vary among suppliers.

# SN54ABT821, SN74ABT821 10-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

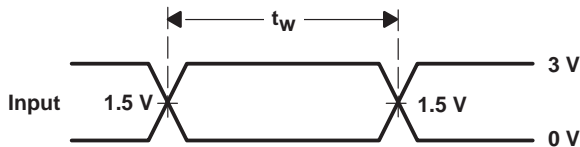
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## PARAMETER MEASUREMENT INFORMATION

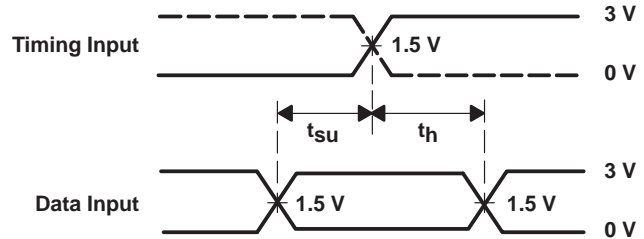


TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open

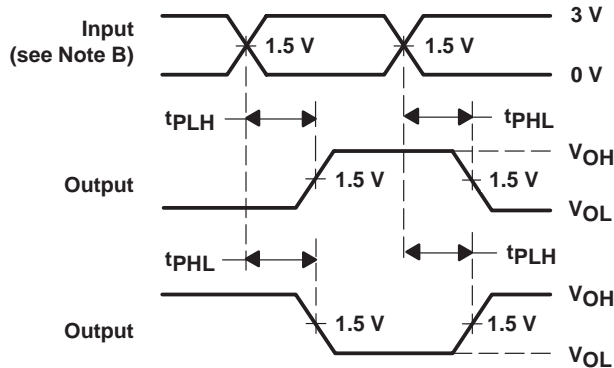
LOAD CIRCUIT FOR OUTPUTS



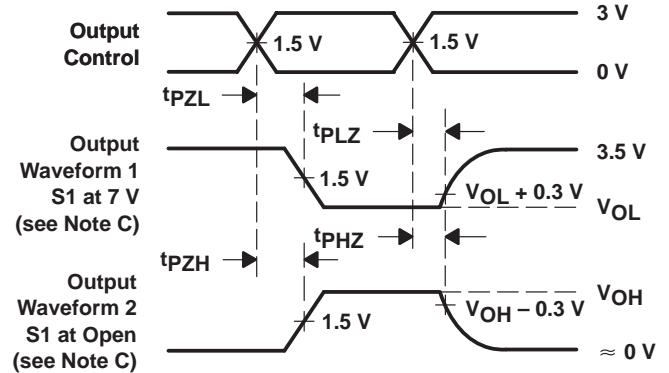
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns.  
 C. 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.  
 D. The outputs are measured one at a time with one 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>
5962-9469101Q3A	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9469101QKA	ACTIVE	CFP	W	24	1	TBD	A42	N / A for Pkg Type
5962-9469101QLA	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
SN74ABT821DBLE	OBSOLETE	SSOP	DB	24		TBD	Call TI	Call TI
SN74ABT821DW	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
SN74ABT821DWR	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
SN74ABT821NT	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI
SNJ54ABT821FK	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54ABT821JT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
SNJ54ABT821W	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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DB (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-150



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

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



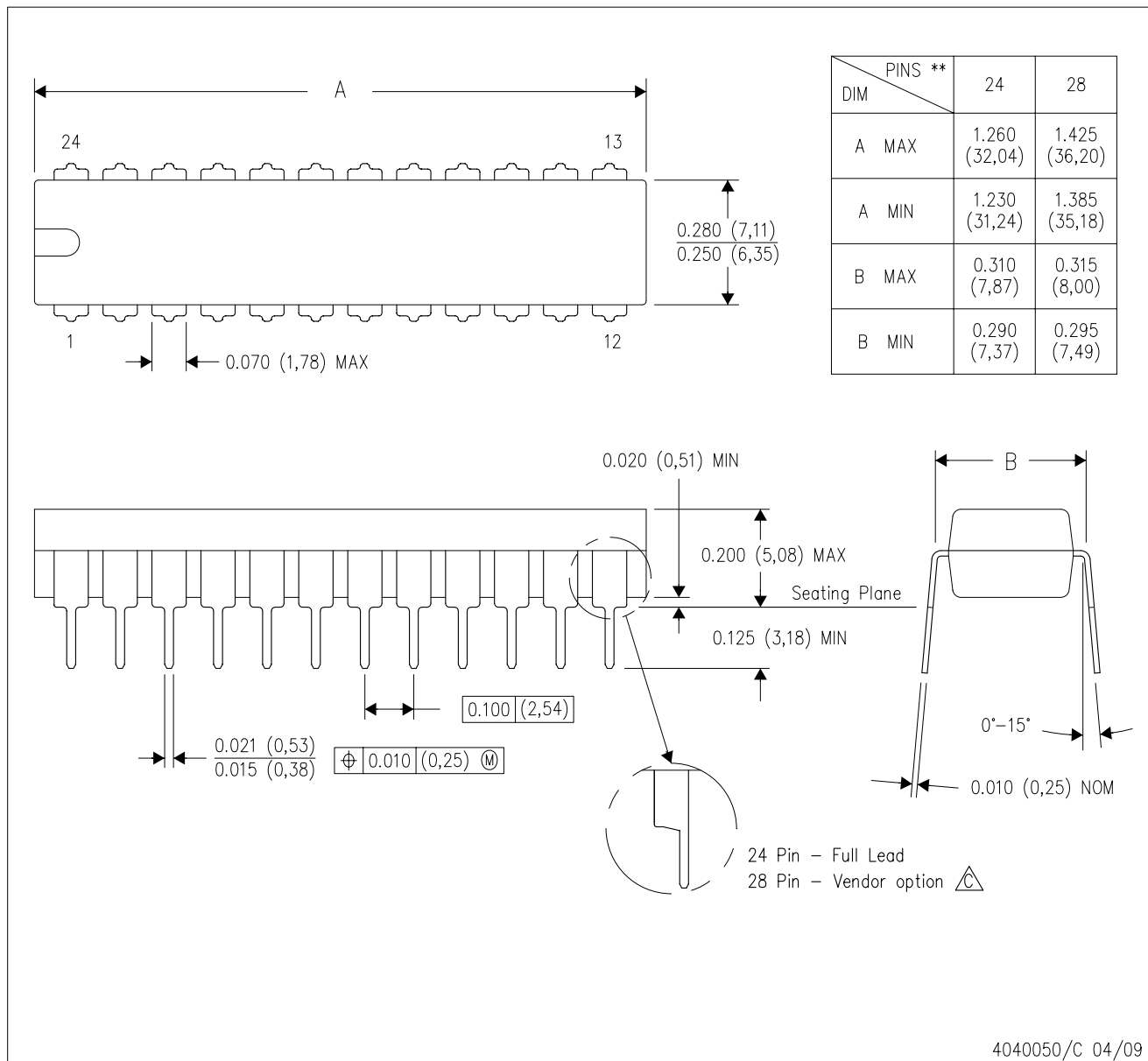
4040140/D 10/96


- 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 metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

# MECHANICAL DATA

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

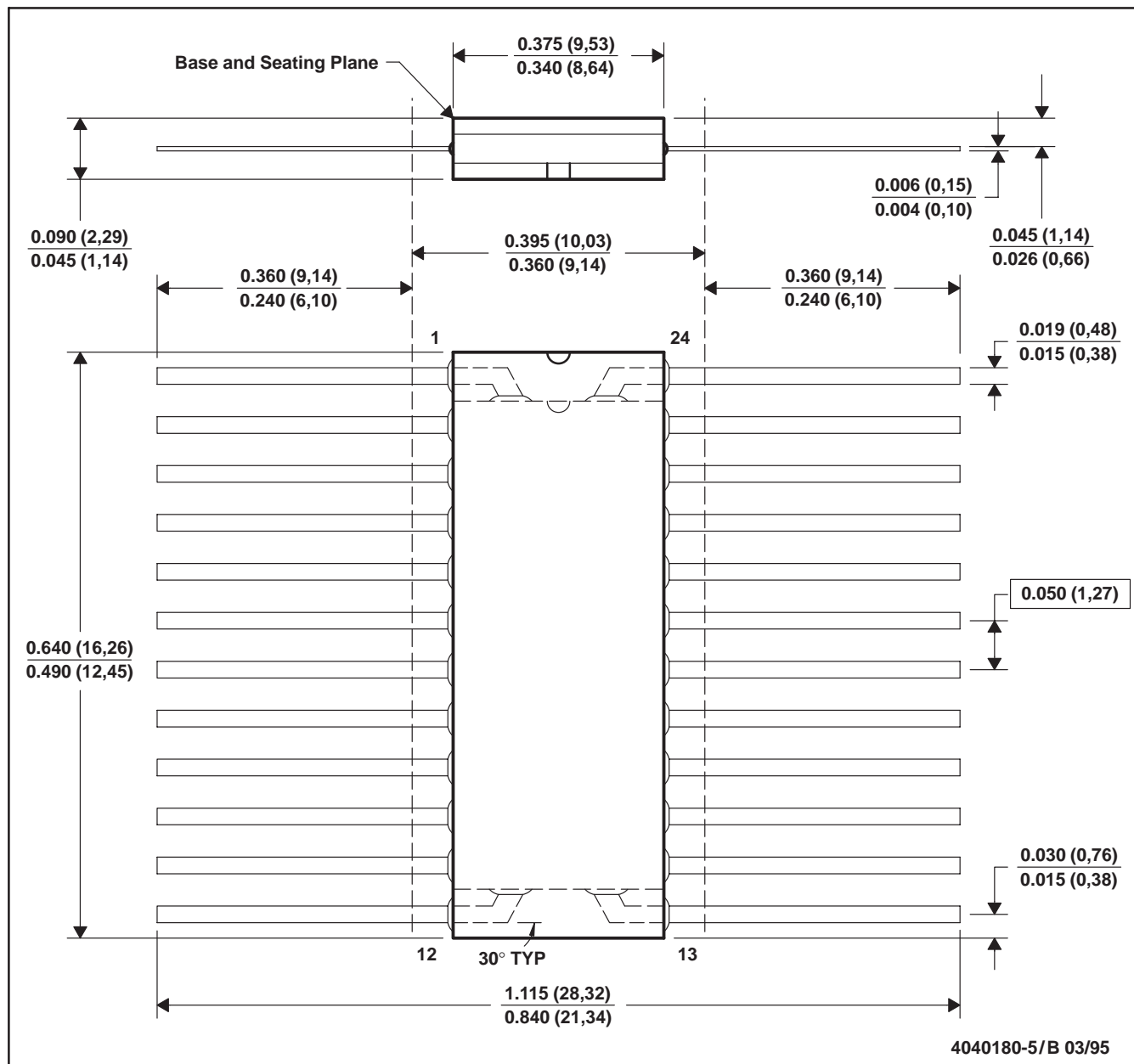
PLASTIC DUAL-IN-LINE PACKAGE



- 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.

W (R-GDFP-F24)

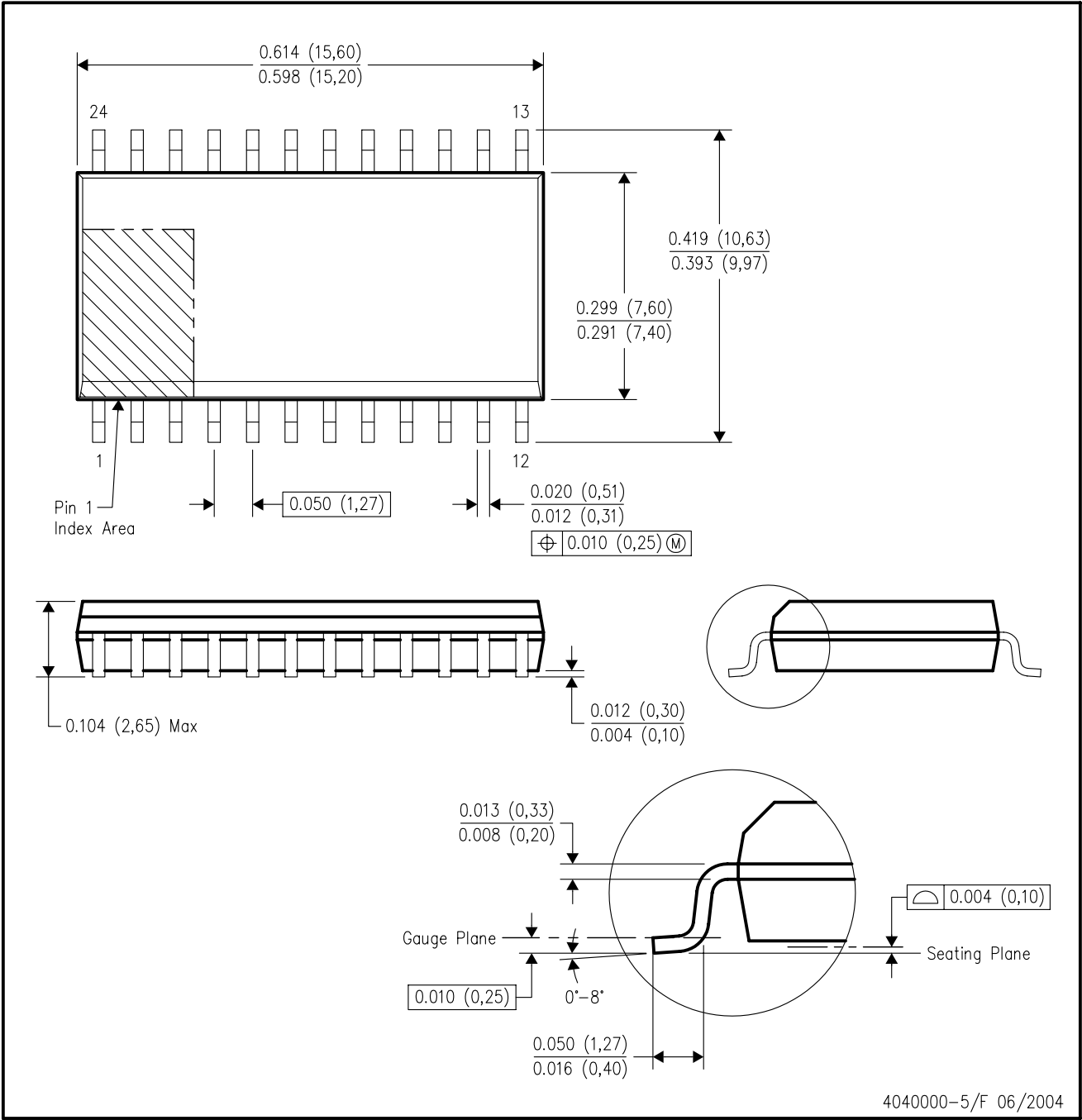
CERAMIC DUAL FLATPACK



- 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. Falls within MIL-STD-1835 GDFP2-F24 and JEDEC MO-070AD  
 E. Index point is provided on cap for terminal identification only.

DW (R-PDSO-G24)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 MS-013 variation AD.

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

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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
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