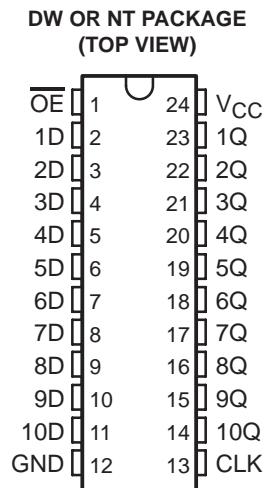


- State-of-the-Art BiCMOS Design  
Significantly Reduces  $I_{CCZ}$
- ESD Protection Exceeds 2000 V Per  
MIL-STD-883C, Method 3015; Exceeds  
200 V Using Machine Model ( $C = 200 \text{ pF}$ ,  
 $R = 0$ )
- 3-State Buffer-Type Outputs Drive Bus  
Lines Directly
- Package Options Include Plastic  
Small-Outline (DW) Packages and Standard  
Plastic 300-mil DIPs (NT)

### description

This 10-bit bus-interface flip-flop features 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. It is 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, the Q outputs will be true to the data (D) inputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the ten 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. The high-impedance state and increased drive provide the capability to drive bus lines without need for interface or pullup components.

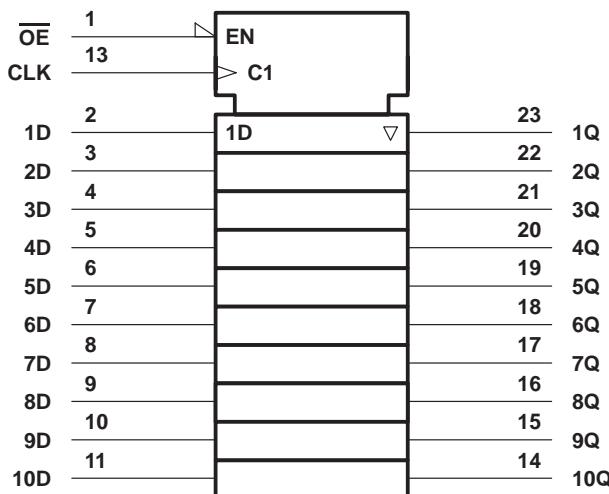
The output enable ( $\overline{OE}$ ) does not affect the internal operation of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The SN74BCT29821 is characterized for operation from 0°C to 70°C.

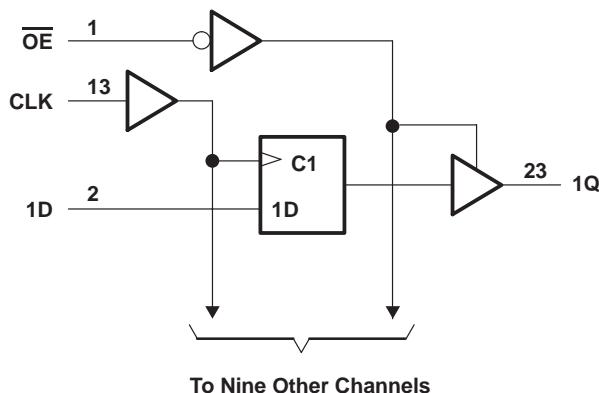
FUNCTION TABLE  
(each flip-flop)

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†



## logic diagram (positive logic)



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

## 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 disabled or power-off state, $V_O$ .....	-0.5 V to 5.5 V
Voltage range applied to any output in the high state, $V_O$ .....	-0.5 V to $V_{CC}$
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	-30 mA
Current into any output in the low state, $I_O$ .....	96 mA
Operating free-air temperature range .....	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.

NOTE 1: The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

## recommended operating conditions

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	4.5	5	5.5	V
$V_{IH}$	High-level input voltage		2		V
$V_{IL}$	Low-level input voltage		0.8		V
$I_{IK}$	Input clamp current			-18	mA
$I_{OH}$	High-level output current			-24	mA
$I_{OL}$	Low-level output current			48	mA
$T_A$	Operating free-air temperature	0	70		°C

**SN74BCT29821**  
**10-BIT BUS-INTERFACE FLIP-FLOP**  
**WITH 3-STATE OUTPUTS**

SCBS021D – FEBRUARY 1989 – REVISED NOVEMBER 1993

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

PARAMETER	TEST CONDITIONS		MIN	TYP†	MAX	UNIT
$V_{IK}$	$V_{CC} = 4.5 \text{ V}$ , $I_I = -18 \text{ mA}$				-1.2	V
$V_{OH}$	$V_{CC} = 4.5 \text{ V}$	$I_{OH} = -15 \text{ mA}$	2.4	3.3		V
		$I_{OH} = -24 \text{ mA}$	2			
$V_{OL}$	$V_{CC} = 4.5 \text{ V}$ , $I_{OL} = 48 \text{ mA}$		0.42	0.55		V
$I_I$	$V_{CC} = 5.5 \text{ V}$ , $V_I = 7 \text{ V}$			0.1		mA
$I_{IH}$	$V_{CC} = 5.5 \text{ V}$ , $V_I = 2.7 \text{ V}$		-10	-75		$\mu\text{A}$
$I_{IL}$	$V_{CC} = 5.5 \text{ V}$ , $V_I = 0.5 \text{ V}$			-0.2		mA
$I_{OS}^{\ddagger}$	$V_{CC} = 5.5 \text{ V}$ , $V_O = 0$		-75	-250		mA
$I_{OZH}$	$V_{CC} = 5.5 \text{ V}$ , $V_O = 2.7 \text{ V}$			20		$\mu\text{A}$
$I_{OZL}$	$V_{CC} = 5.5 \text{ V}$ , $V_O = 0.5 \text{ V}$			-20		$\mu\text{A}$
$I_{CCL}$	$V_{CC} = 5.5 \text{ V}$ , Outputs open		25	35		mA
$I_{CCH}$	$V_{CC} = 5.5 \text{ V}$ , Outputs open		6	10		mA
$I_{CCZ}$	$V_{CC} = 5.5 \text{ V}$ , Outputs open		2	6		mA
$C_i$	$V_{CC} = 5 \text{ V}$ , $V_I = 2.5 \text{ V or } 0.5 \text{ V}$			5.5		pF
$C_o$	$V_{CC} = 5 \text{ V}$ , $V_O = 2.5 \text{ V or } 0.5 \text{ V}$			7		pF

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

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

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

			$V_{CC} = 5 \text{ V}$ , $T_A = 25^\circ\text{C}$		MIN	MAX	UNIT
			MIN	MAX			
$f_{clock}$	Clock frequency		0	125	0	125	MHz
$t_w$	Pulse duration, CLK high or low		7		7		ns
$t_{su}$	Setup time, data before $\text{CLK}^\uparrow$	High or low	7		7		ns
$t_h$	Hold time, data after $\text{CLK}^\uparrow$	High or low	1		1		ns

**switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50 \text{ pF}$  (unless otherwise noted) (see Note 2)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 5 \text{ V}$ , $T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
			MIN	TYP	MAX			
$f_{max}$			125		125			MHz
$t_{PLH}$	CLK	Q	1.5	7.5	10	1.5	12	ns
$t_{PHL}$			1.5	6.5	9	1.5	10	
$t_{PZH}$	$\overline{OE}$	Q	2	7.5	10	2	12	ns
$t_{PZL}$			2	9	12	2	13	
$t_{PHZ}$	$\overline{OE}$	Q	2	5	7	2	8	ns
$t_{PLZ}$			2	5	7	2	8	

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.



**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>
SN74BCT29821DWE4	ACTIVE	SOIC	DW	24		TBD	Call TI	Call TI
SN74BCT29821DWG4	ACTIVE	SOIC	DW	24		TBD	Call TI	Call TI
SN74BCT29821DWRE4	ACTIVE	SOIC	DW	24		TBD	Call TI	Call TI
SN74BCT29821DWRG4	ACTIVE	SOIC	DW	24		TBD	Call TI	Call TI
SN74BCT29821NTE4	ACTIVE	PDIP	NT	24		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), 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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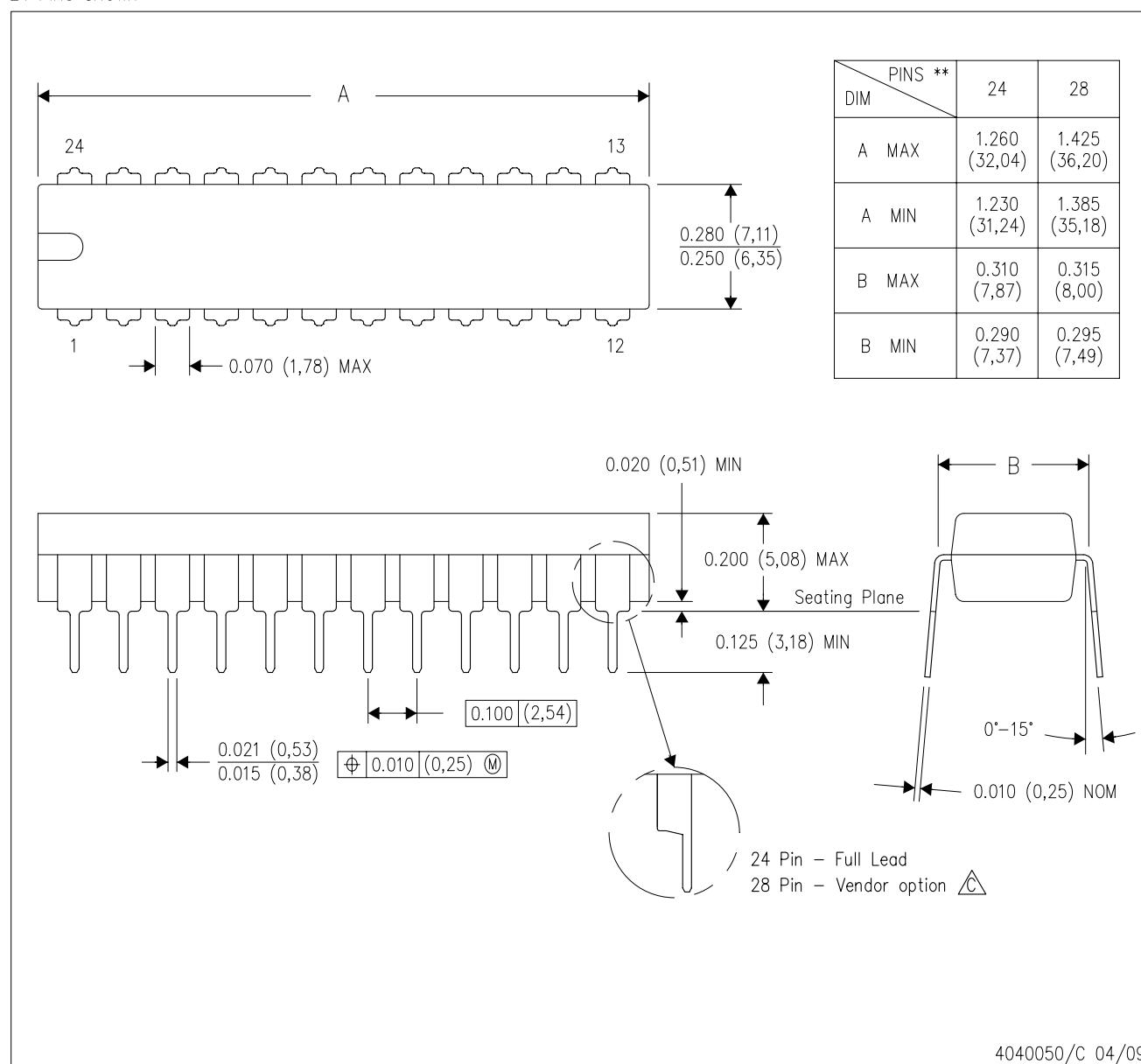
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## MECHANICAL DATA

NT (R-PDIP-T\*\*)

24 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



4040050/C 04/09

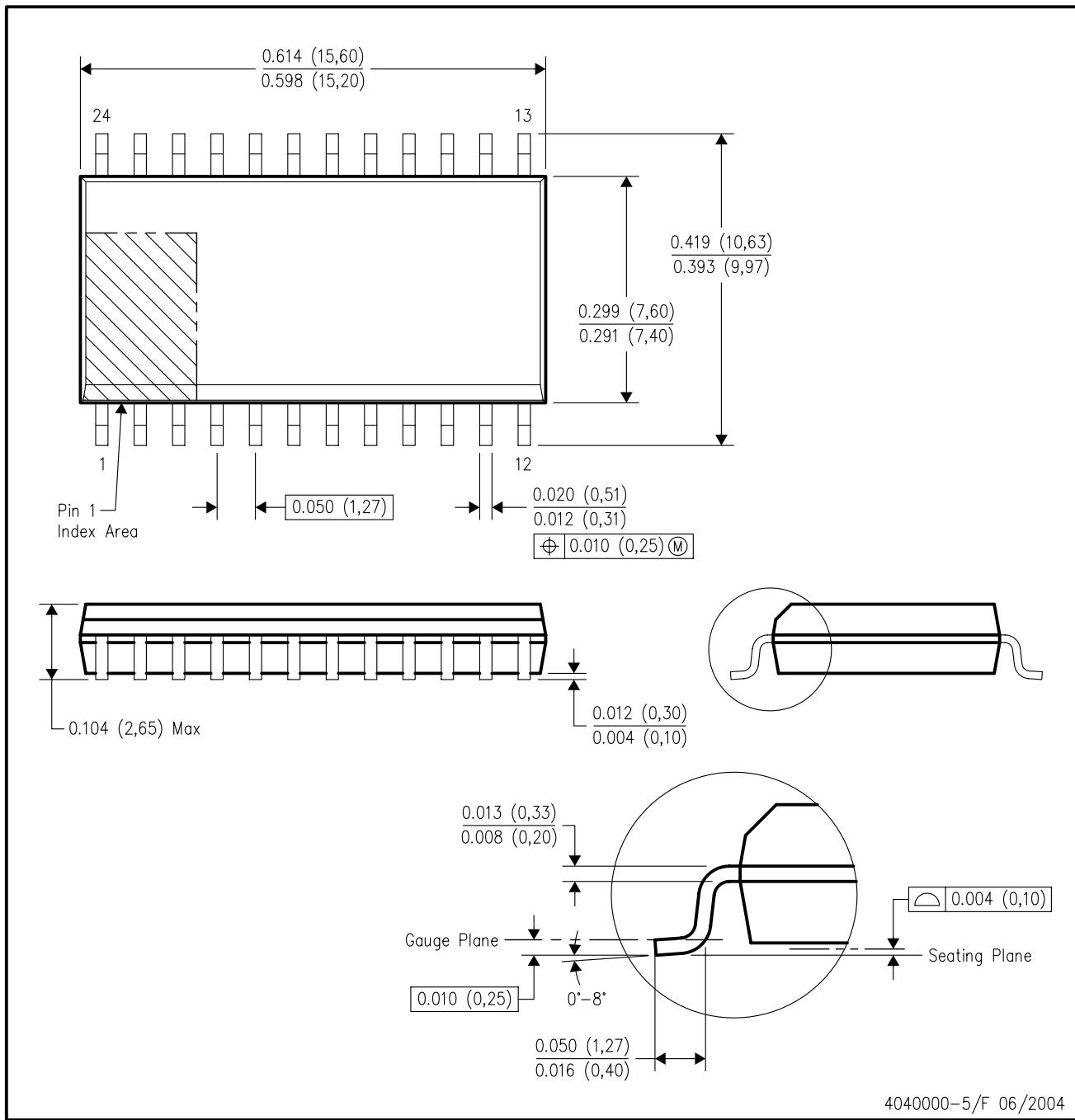
NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.

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 PACKAGE



NOTES:

- All linear dimensions are in inches (millimeters).
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0.15).
- Falls within JEDEC MS-013 variation AD.

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