

# SN54ABT821, SN74ABT821A 10-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCBS193E – FEBRUARY 1991 – REVISED MAY 1997

- State-of-the-Art *EPIC-II<sup>TM</sup>* BiCMOS Design Significantly Reduces Power Dissipation
- ESD Protection Exceeds 2000 V Per MIL-STD-883, 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-Impedance State During Power Up and Power Down
- 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), Ceramic Flat (W) Package, and Plastic (NT) and Ceramic (JT) DIPs

## 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 devices provide true data at the Q outputs.

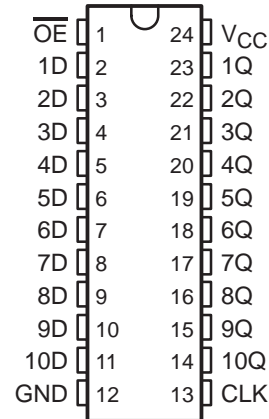
A buffered output-enable ( $\overline{OE}$ ) input can be used to place the ten outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased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

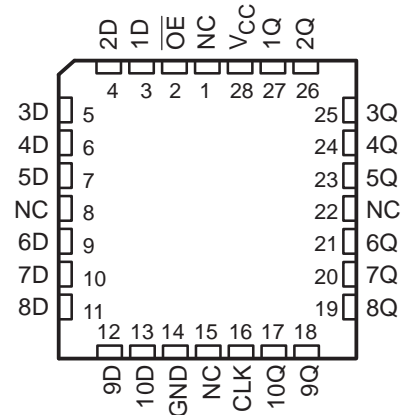
When  $V_{CC}$  is between 0 and 2.1 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 2.1 V,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54ABT821 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT821A is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54ABT821 . . . JT OR W PACKAGE  
SN74ABT821A . . . DB, DW, OR NT PACKAGE  
(TOP VIEW)



SN54ABT821 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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**TEXAS  
INSTRUMENTS**

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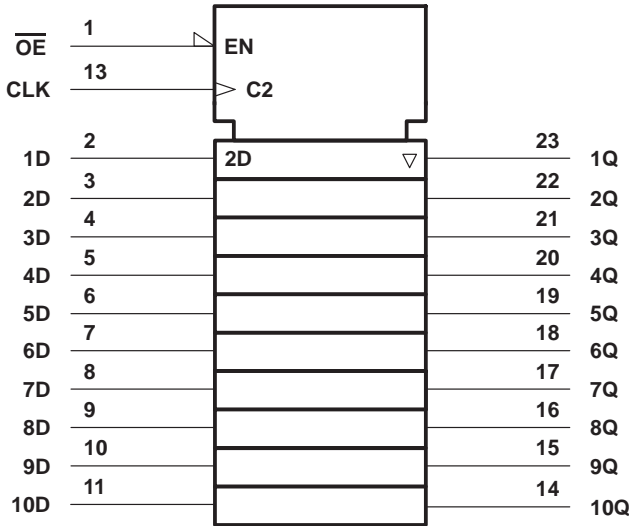
SN54ABT821, SN74ABT821A  
10-BIT BUS-INTERFACE FLIP-FLOPS  
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FUNCTION TABLE  
(each flip-flop)

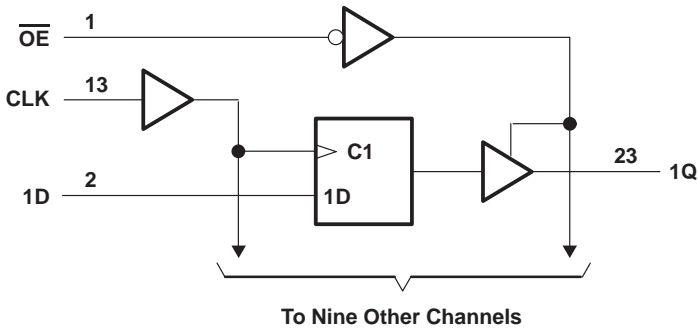
INPUTS			OUTPUT Q
$\overline{\text{OE}}$	CLK	D	
L	↑	H	H
L	↑	L	L
L	H or L	X	$Q_0$
H	X	X	Z

logic symbol†



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

logic diagram (positive logic)



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

# SN54ABT821, SN74ABT821A

## 10-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)<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 7 V
Voltage range applied to any output in the high 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
SN74ABT821A	128 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ )	–18 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ )	–50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DB package	104°C/W
DW package	81°C/W
NT package	67°C/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 negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.  
2. The package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51, except for through-hole packages, which use a trace length of zero.

#### recommended operating conditions (see Note 3)

		SN54ABT821		SN74ABT821A		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		μs/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.

# SN54ABT821, SN74ABT821A

## 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		SN74ABT821A		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			2					
				2*				2	
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V			0.55		0.55			V
				0.55*				0.55	
V <sub>hys</sub>			100						mV
I <sub>I</sub>	V <sub>CC</sub> = 0 to 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	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	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			50		50		50	μA
I <sub>O</sub> §	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V	-50	-100	-180	-50	-180	-50	-180	mA
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND			1	250	250		250	μA
				24	38	38		38	mA
				0.5	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			3.5					pF
C <sub>O</sub>	V <sub>O</sub> = 2.5 V or 0.5 V			7.5					pF

\* On products compliant to MIL-PRF-38535, this parameter does not apply.

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

‡ This parameter is characterized, but not production tested.

§ 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		SN74ABT821A		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			2.9		2.9		ns
				3.8		3.8		
t <sub>su</sub>	Setup time, data before CLK↑		2.1		2.1		2.1	ns
t <sub>h</sub>	Hold time, data after CLK↑		1.3		1.3		1.3	ns



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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)	SN54ABT821				UNIT	
			V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C			MIN		MAX
			MIN	TYP	MAX			
f <sub>max</sub>			125			125	MHz	
t <sub>PLH</sub>	CLK	Q	1.6†	4.1	5.6	1.6†	6.9	ns
t <sub>PHL</sub>			2.1†	4.6	6.2	2.1†	6.9	
t <sub>PZH</sub>	OE	Q	1	3	4.5	1	6	ns
t <sub>PZL</sub>			2.2	4.1	5.6	2.2	6.5	
t <sub>PHZ</sub>	OE	Q	2.7	4.7	6.2	2.7	7	ns
t <sub>PLZ</sub>			1.7†	4.6	6.1	1.7†	7	

† This data sheet limit may vary among suppliers.

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)	SN74ABT821A				UNIT	
			V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C			MIN		MAX
			MIN	TYP	MAX			
f <sub>max</sub>			125			125	MHz	
t <sub>PLH</sub>	CLK	Q	1.6†	4.1	5.6	1.6†	6.2	ns
t <sub>PHL</sub>			2.3†	4.6	6.2	2.3†	6.7	
t <sub>PZH</sub>	OE	Q	1	3	4.5	1	5.8	ns
t <sub>PZL</sub>			2.2	4.1	5.6	2.2	6.3	
t <sub>PHZ</sub>	OE	Q	2.7	4.7	6.2	2.7	6.7	ns
t <sub>PLZ</sub>			1.7†	4.6	6.1	1.7†	6.5	

† This data sheet limit may vary among suppliers.

# SN54ABT821, SN74ABT821A

## 10-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
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



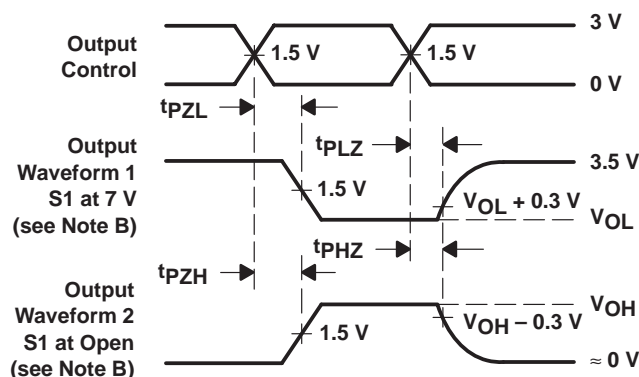
VOLTAGE WAVEFORMS  
PULSE DURATION



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. 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. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - 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 (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9469101QLA	ACTIVE	CDIP	JT	24	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-9469101QL A SNJ54ABT821JT	<a href="#">Samples</a>
SN74ABT821ADW	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT821A	<a href="#">Samples</a>
SN74ABT821ADWG4	ACTIVE	SOIC	DW	24	25	TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
SN74ABT821ADWR	ACTIVE	SOIC	DW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT821A	<a href="#">Samples</a>
SN74ABT821ADWRG4	ACTIVE	SOIC	DW	24	2000	TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
SNJ54ABT821JT	ACTIVE	CDIP	JT	24	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-9469101QL A SNJ54ABT821JT	<a href="#">Samples</a>

(1) 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.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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## TAPE AND REEL INFORMATION



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74ABT821ADWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABT821ADWR	SOIC	DW	24	2000	350.0	350.0	43.0

## TUBE



\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN74ABT821ADW	DW	SOIC	24	25	506.98	12.7	4826	6.6

DW (R-PDSO-G24)

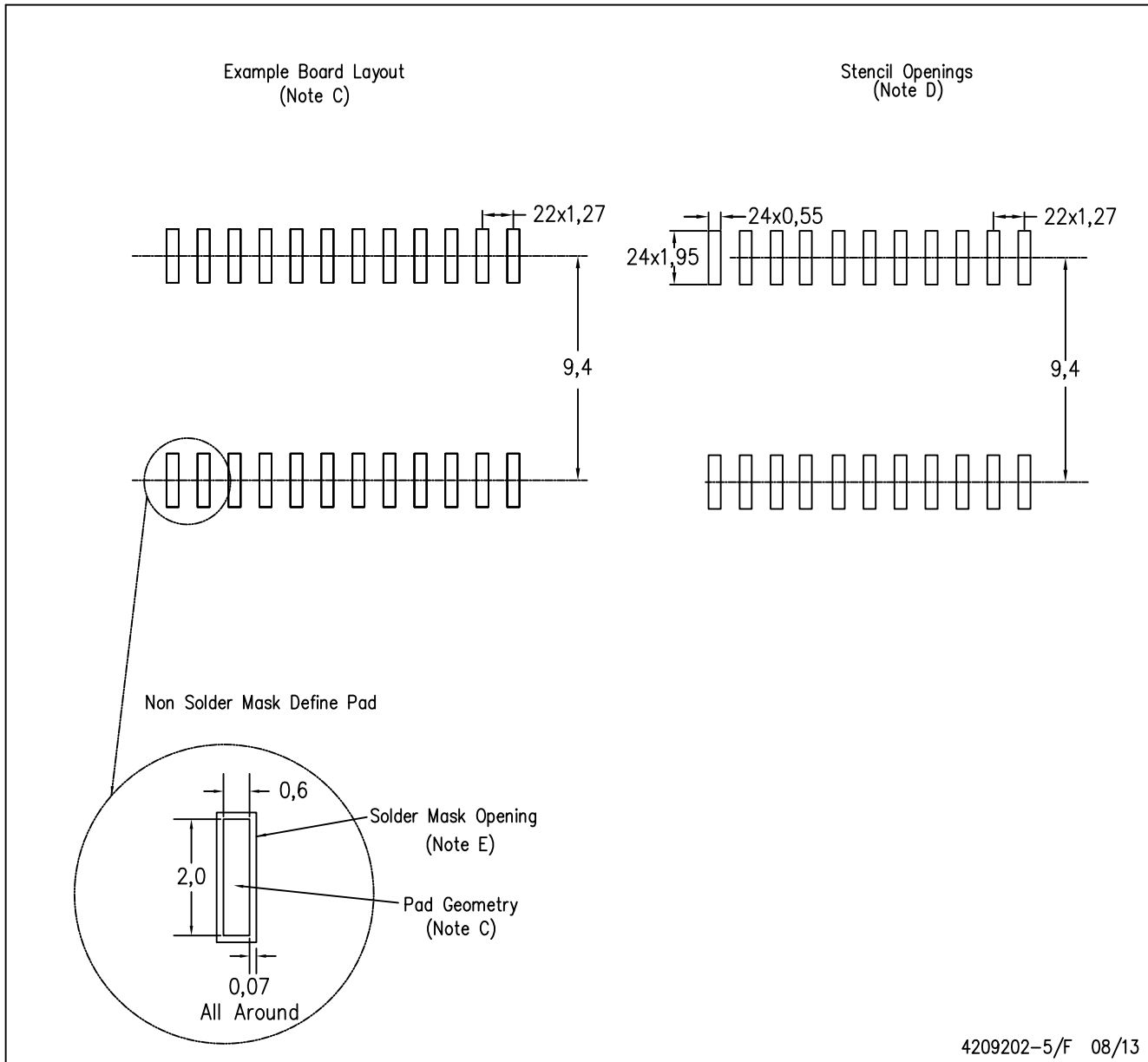
PLASTIC SMALL OUTLINE



- 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.

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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

## CERAMIC DUAL-IN-LINE

24 LEADS SHOWN



- 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.
  - Index point is provided on cap for terminal identification.
  - Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

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