

# SN54ABT2241, SN74ABT2241 OCTAL BUFFERS AND LINE/MOS DRIVERS WITH 3-STATE OUTPUTS

SCBS233B – JANUARY 1991 – REVISED JANUARY 1997

- Output Ports Have Equivalent 25- $\Omega$  Series Resistors, So No External Resistors Are Required
- State-of-the-Art *EPIC-II<sup>B</sup>*™ BiCMOS Design Significantly Reduces Power Dissipation
- Typical  $V_{OLP}$  (Output Ground Bounce) < 1 V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Chip Carriers (FK), and Plastic (N) and Ceramic (J) DIPs

## description

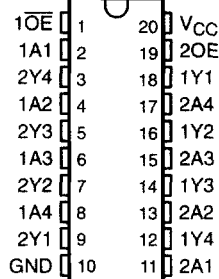
These octal buffers and line drivers are designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. Together with the SN54ABT2240, SN74ABT2240A and 'ABT2244A, these devices provide the choice of selected combinations of inverting and noninverting outputs, symmetrical active-low output-enable ( $\overline{OE}$ ) inputs, and complementary OE and  $\overline{OE}$  inputs. These devices feature high fan-out and improved fan-in.

The outputs, which are designed to sink up to 12 mA, include equivalent 25- $\Omega$  series resistors to reduce overshoot and undershoot.

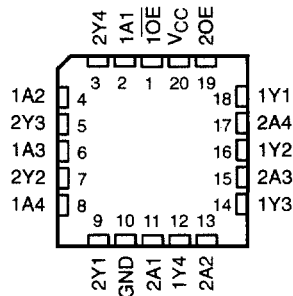
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver. OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

The SN54ABT2241 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT2241 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54ABT2241 . . . J PACKAGE  
SN74ABT2241 . . . DB, DW, N, OR PW PACKAGE  
(TOP VIEW)



SN54ABT2241 . . . FK PACKAGE  
(TOP VIEW)



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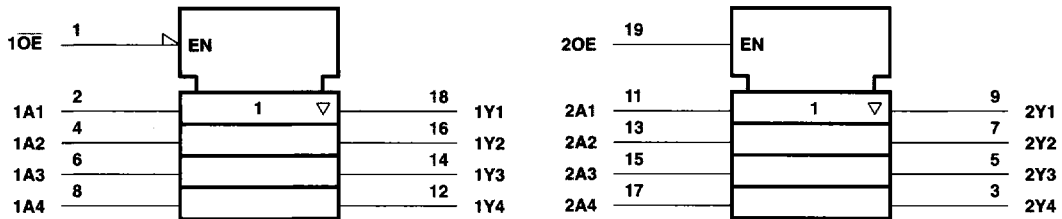
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**FUNCTION TABLES**

| INPUTS           |    | OUTPUT |
|------------------|----|--------|
| $\overline{1OE}$ | 1A | 1Y     |
| L                | H  | H      |
| L                | L  | L      |
| H                | X  | Z      |

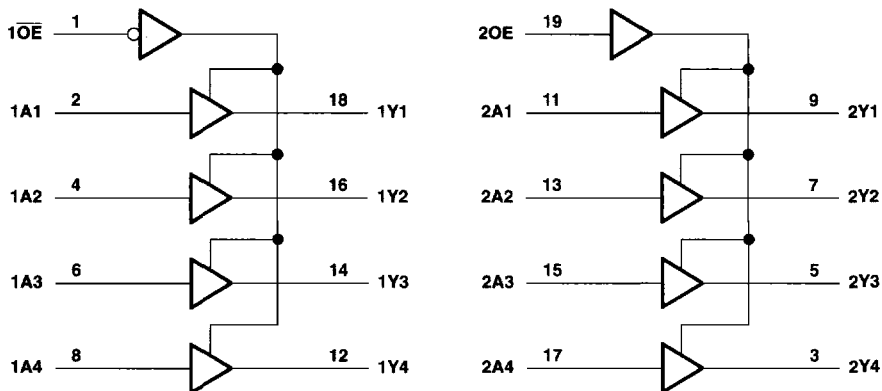
| INPUTS |    | OUTPUT |
|--------|----|--------|
| 2OE    | 2A | 2Y     |
| H      | H  | H      |
| H      | L  | L      |
| L      | X  | Z      |

**logic symbol†**



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

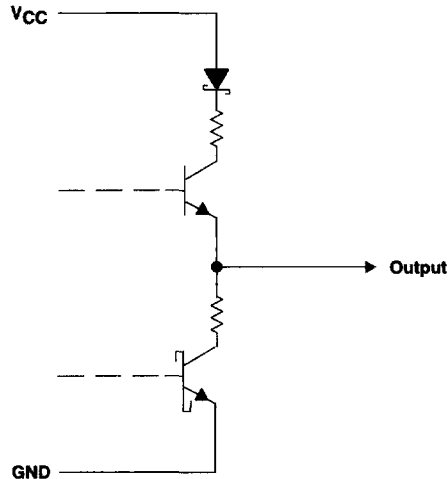
**logic diagram (positive logic)**



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**schematic of Y outputs**



**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 or power-off state, $V_O$ ..... | -0.5 V to 5.5 V |
| Current into any output in the low state, $I_O$ .....                           | 30 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 .....  | 115°C/W         |
| DW package .....  | 97°C/W          |
| N package .....   | 67°C/W          |
| PW package .....  | 128°C/W         |
| Storage temperature range, $T_{stg}$ .....                                      | -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.

- 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.

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## recommended operating conditions (see Note 3)

|                 |                                    | SN54ABT2241     |                 | SN74ABT2241 |                 | UNIT |
|-----------------|------------------------------------|-----------------|-----------------|-------------|-----------------|------|
|                 |                                    | MIN             | MAX             | MIN         | MAX             |      |
| V <sub>CC</sub> | Supply voltage                     | 4.5             | 5.5             | 4.5         | 5.5             | V    |
| V <sub>IH</sub> | High-level input voltage           | 2               |                 | 2           |                 | V    |
| V <sub>IL</sub> | Low-level input voltage            |                 | 0.8             |             | 0.8             | V    |
| V <sub>I</sub>  | Input voltage                      | 0               | V <sub>CC</sub> | 0           | V <sub>CC</sub> | V    |
| I <sub>OH</sub> | High-level output current          |                 | -24             |             | -32             | mA   |
| I <sub>OL</sub> | Low-level output current           |                 | 12              |             | 12              | mA   |
| Δt/Δv           | Input transition rise or fall rate | Outputs enabled |                 | 5           | 5               | ns/V |
| T <sub>A</sub>  | Operating free-air temperature     | -55             | 125             | -40         | 85              | °C   |

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

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

| PARAMETER          |                | TEST CONDITIONS  |  | T <sub>A</sub> = 25°C |               | SN54ABT2241 |          | SN74ABT2241 |          | UNIT |
|--------------------|----------------|--|--|-----------------------|---------------|-------------|----------|-------------|----------|------|
|                    |                |  |  | MIN                   | TYP†          | MAX         | MIN      | MAX         | MIN      |      |
| 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                 | 2                     |               | 2           |          |             |          |      |
|                    |                |  | I <sub>OH</sub> = -32 mA                 | 2*                    |               |             | 2        |             |          |      |
| V <sub>OL</sub>    |                | V <sub>CC</sub> = 4.5 V,   | I <sub>OL</sub> = 12 mA                  |                       | 0.8           |             | 0.8      |             | 0.8      | V    |
| V <sub>hys</sub>   |                |  |  |                       | 100           |             |          |             |          | mV   |
| 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>OZH</sub>   |                | V <sub>CC</sub> = 5.5 V,   | V <sub>O</sub> = 2.7 V                   |                       | 50            |             | 50       |             | 50       | μA   |
| I <sub>OZL</sub>   |                | V <sub>CC</sub> = 5.5 V,   | V <sub>O</sub> = 0.5 V                   |                       | -50           |             | -50      |             | -50      | 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          |          | 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,<br>I <sub>O</sub> = 0,<br>V <sub>I</sub> = V <sub>CC</sub> or GND   | Outputs high                             |                       | 1 250         |             | 250      |             | 250      | μA   |
|                    |                |  | Outputs low                              |                       | 24 30         |             | 30       |             | 30       | mA   |
|                    |                |  | Outputs disabled                         |                       | 0.5 250       |             | 250      |             | 250      | μA   |
| ΔI <sub>CC</sub> § | Data inputs    | V <sub>CC</sub> = 5.5 V,<br>One input at 3.4 V,<br>Other inputs at<br>V <sub>CC</sub> or GND | Outputs enabled                          |                       | 1.5           |             | 1.5      |             | 1.5      | mA   |
|                    |                |  | Outputs disabled                         |                       | 0.05          |             | 0.05     |             | 0.05     |      |
|                    | Control inputs | V <sub>CC</sub> = 5.5 V, One input at 3.4 V,<br>Other inputs at V <sub>CC</sub> or GND       |  |                       | 1.5           |             | 1.5      |             | 1.5      |      |
| C <sub>i</sub>     | C <sub>i</sub> | V <sub>I</sub> = 2.5 V or 0.5 V  |  |                       | 3             |             |          |             |          | pF   |
| C <sub>o</sub>     | C <sub>o</sub> | V <sub>O</sub> = 2.5 V or 0.5 V  |  |                       | 8.5           |             |          |             |          | pF   |

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

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

‡ 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.

PRODUCT PREVIEW Information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



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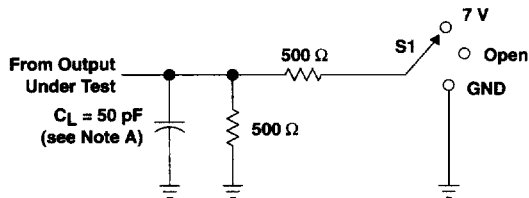
switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT)          | TO (OUTPUT) | $V_{CC} = 5$ V,<br>$T_A = 25^\circ$ C |     |     | SN54ABT2241 |     | SN74ABT2241 |     | UNIT |
|-----------|-----------------------|-------------|---------------------------------------|-----|-----|-------------|-----|-------------|-----|------|
|           |                       |             | MIN                                   | TYP | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{PLH}$ | A                     | Y           | 1                                     | 3   | 4.3 | 1           | 4.8 | 1           | 4.7 | ns   |
| $t_{PHL}$ |                       |             | 1                                     | 4.3 | 5.3 | 1           | 5.7 | 1           | 5.6 |      |
| $t_{PZH}$ | OE or $\overline{OE}$ | Y           | 1.1                                   | 3.5 | 4.8 | 1           | 6.1 | 1.1         | 5.8 | ns   |
| $t_{PZL}$ |                       |             | 2.1                                   | 6.2 | 7.6 | 1           | 8.6 | 2.1         | 8.4 |      |
| $t_{PHZ}$ | OE or $\overline{OE}$ | Y           | 1.7                                   | 4.2 | 5.6 | 1.7         | 6.7 | 1.7         | 6.6 | ns   |
| $t_{PLZ}$ |                       |             | 1.7                                   | 3.9 | 5.8 | 1.7         | 6.9 | 1.7         | 6.4 |      |

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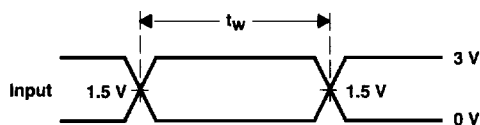
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## PARAMETER MEASUREMENT INFORMATION

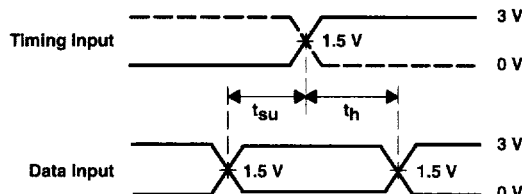


LOAD CIRCUIT

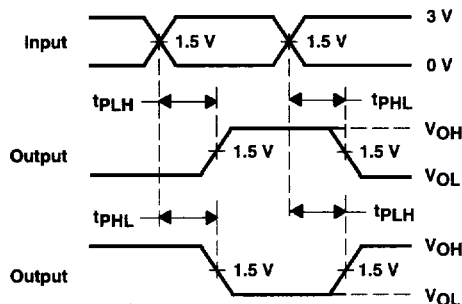
| TEST              | S1   |
|-------------------|------|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | 7 V  |
| $t_{PHZ}/t_{PZH}$ | Open |



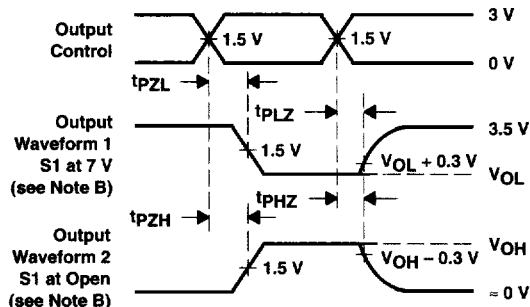
VOLTAGE WAVEFORMS  
PULSE DURATION



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