

# SN54ABT5401, SN74ABT5401 11-BIT LINE/MEMORY DRIVERS WITH 3-STATE OUTPUTS

SCBS235B – JUNE 1992 – REVISED JANUARY 1997

- Output Ports Have Equivalent 25-Ω Series Resistors, So No External Resistors Are Required
- State-of-the-Art *EPIC-IIB*™ BiCMOS Design Significantly Reduces Power Dissipation
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Typical  $V_{OLP}$  (Output Ground Bounce) < 1 V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OLV}$  (Output Undershoot) < 0.5 V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- Package Options Include Plastic Small-Outline (DW) Package, Ceramic Chip Carriers (FK), and DIPs (JT)

## description

These 11-bit 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.

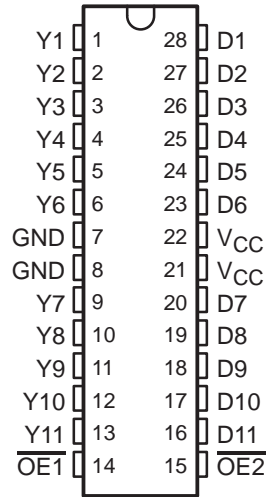
The 3-state control gate is a 2-input AND gate with active-low inputs so that if either output-enable ( $\overline{OE1}$  or  $\overline{OE2}$ ) input is high, all 11 outputs are in the high-impedance state. These devices provide inverted data.

The outputs, which are designed to source or sink up to 12 mA, include equivalent 25-Ω series resistors to reduce overshoot and undershoot.

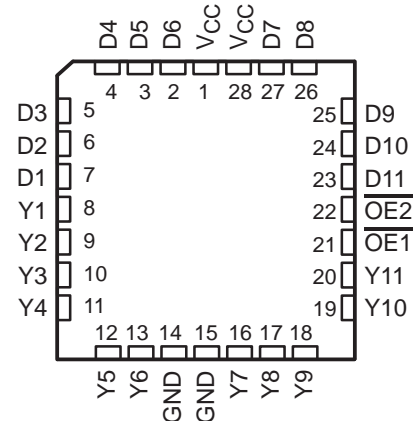
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54ABT5401 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT5401 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54ABT5401 . . . JT PACKAGE  
SN74ABT5401 . . . DW PACKAGE  
(TOP VIEW)



SN54ABT5401 . . . FK PACKAGE  
(TOP VIEW)



FUNCTION TABLE

| INPUTS           |                  |   | OUTPUT |
|------------------|------------------|---|--------|
| $\overline{OE1}$ | $\overline{OE2}$ | D | Y      |
| L                | L                | L | H      |
| L                | L                | H | L      |
| H                | X                | X | Z      |
| X                | H                | X | Z      |



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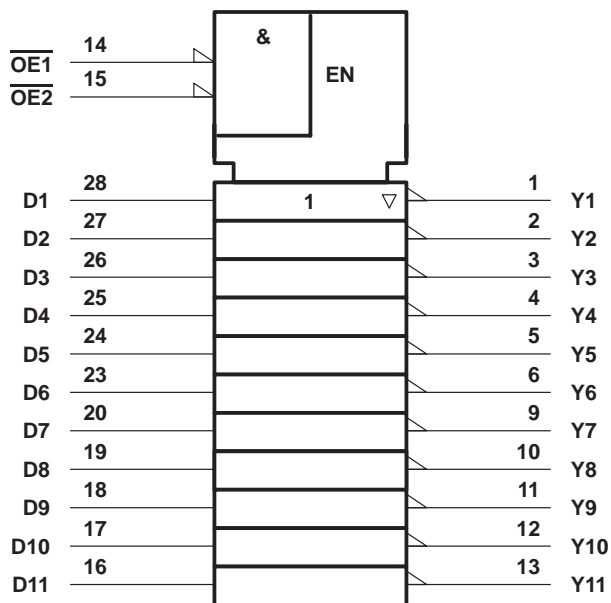
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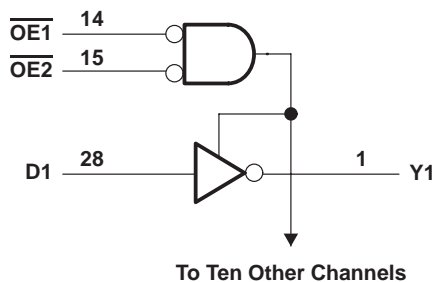
**SN54ABT5401, SN74ABT5401**  
**11-BIT LINE/MEMORY DRIVERS**  
**WITH 3-STATE OUTPUTS**

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**logic symbol†**



**logic diagram (positive logic)**



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

Pin numbers shown are for the DW and JT packages.

**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): DW package .....         | 78°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.

# SN54ABT5401, SN74ABT5401 11-BIT LINE/MEMORY DRIVERS WITH 3-STATE OUTPUTS

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## recommended operating conditions (see Note 3)

|                 |                                    | SN54ABT5401     |                 | SN74ABT5401 |                 | 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          |                 | -12             |             | -12             | mA   |
| I <sub>OL</sub> | Low-level output current           |                 | 12              |             | 12              | mA   |
| Δt/Δv           | Input transition rise or fall rate | Outputs enabled |                 |             | 10              | 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 |      |      | SN54ABT5401 |      | SN74ABT5401 |      | 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> = -1 mA                  | 3.35                  | 3.7  |      | 3.3         |      | 3.35        |      | V    |
|                    |                | V <sub>CC</sub> = 5 V,   | I <sub>OH</sub> = -1 mA                  | 3.85                  | 4.2  |      | 3.8         |      | 3.85        |      |      |
|                    |                | V <sub>CC</sub> = 4.5 V  | I <sub>OH</sub> = -3 mA                  |                       |      |      | 3           |      | 3.1         |      |      |
| V <sub>OL</sub>    |                | V <sub>CC</sub> = 4.5 V  | I <sub>OL</sub> = 8 mA                   |                       |      |      |             | 0.8  |             | 0.65 | V    |
|                    |                |  | I <sub>OL</sub> = 12 mA                  |                       |      |      |             |      |             | 0.8  |      |
| 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,<br>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                   | -25                   | -45  | -100 | -25         | -100 | -25         | -100 | mA   |
| I <sub>OS‡</sub>   |                | V <sub>CC</sub> = 5.5 V,   | V <sub>O</sub> = 0                       | -50                   |      | -200 | -50         | -200 | -50         | -200 | 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                             |                       | 5    | 50   |             | 50   |             | 50   | μA   |
|                    |                |  | Outputs low                              |                       | 36   | 45   |             | 45   |             | 45   | mA   |
|                    |                |  | Outputs disabled                         |                       | 1    | 50   |             | 50   |             | 50   | 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>     |                | V <sub>I</sub> = 2.5 V or 0.5 V  |  |                       | 3    |      |             |      |             |      | pF   |
| C <sub>o</sub>     |                | V <sub>O</sub> = 2.5 V or 0.5 V  |  |                       | 8    |      |             |      |             |      | pF   |

† 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.

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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)

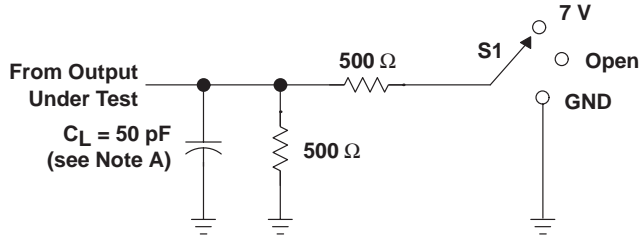
| PARAMETER | FROM (INPUT)    | TO (OUTPUT) | $V_{CC} = 5$ V,<br>$T_A = 25^\circ$ C |     |     | SN54ABT5401 |     | SN74ABT5401 |     | UNIT |
|-----------|-----------------|-------------|---------------------------------------|-----|-----|-------------|-----|-------------|-----|------|
|           |                 |             | MIN                                   | TYP | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{PLH}$ | D               | Y           | 2                                     | 4.5 | 6.1 | 2           | 7   | 2           | 6.9 | ns   |
| $t_{PHL}$ |                 |             | 1.5                                   | 4.4 | 5.2 | 1.5         | 5.9 | 1.5         | 5.7 |      |
| $t_{PZH}$ | $\overline{OE}$ | Y           | 2.5                                   | 5.7 | 6.6 | 2.5         | 8.6 | 2.5         | 8.5 | ns   |
| $t_{PZL}$ |                 |             | 2                                     | 4.4 | 5.5 | 2           | 6.9 | 2           | 6.8 |      |
| $t_{PHZ}$ | $\overline{OE}$ | Y           | 1.5                                   | 3.6 | 4.4 | 1.5         | 5.5 | 1.5         | 5.2 | ns   |
| $t_{PLZ}$ |                 |             | 1.5                                   | 4.2 | 5.4 | 1.5         | 7.4 | 1.5         | 6.9 |      |

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PARAMETER MEASUREMENT INFORMATION

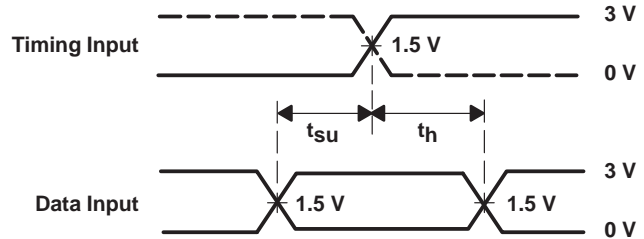


LOAD CIRCUIT

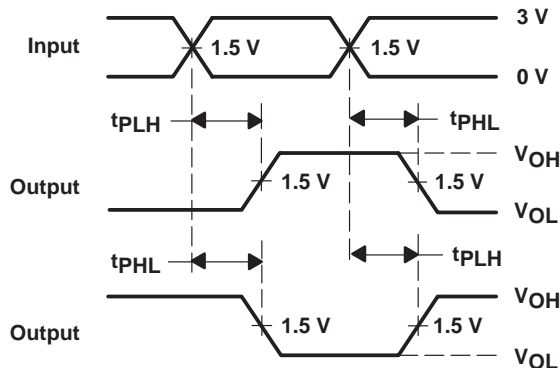
| TEST              | S1   |
|-------------------|------|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | 7 V  |
| $t_{PHZ}/t_{PZH}$ | Open |



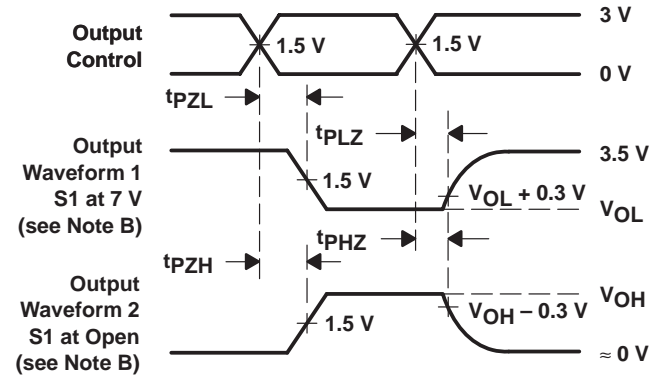
VOLTAGE WAVEFORMS  
PULSE DURATION



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 <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74ABT5401DW    | ACTIVE                | SOIC         | DW              | 28   | 20          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT5401DWE4  | ACTIVE                | SOIC         | DW              | 28   | 20          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT5401DWG4  | ACTIVE                | SOIC         | DW              | 28   | 20          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<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.

**OBSELETE:** 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.

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**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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| 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>           |
| Interface                   | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic                       | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt                  | <a href="http://power.ti.com">power.ti.com</a>                     |
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| RFID                        | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>               |
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