



## 54AC/74AC541

### Octal Buffer/Line Driver with TRI-STATE® Outputs

#### General Description

The 'AC541 is an octal buffer/line driver designed to be employed as memory and address drivers, clock drivers and bus oriented transmitter/receivers. The 'AC541 is a noninverting option of the 'AC540.

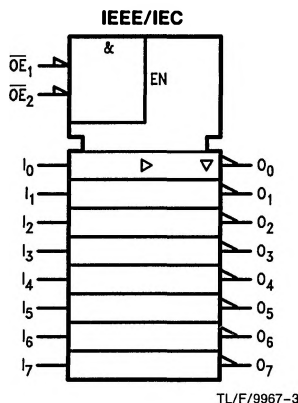
This device is similar in function to the 'AC244 while providing flow-through architecture (inputs on opposite side from outputs). This pinout arrangement makes this device especially useful as an output port for microprocessors, allowing ease of layout and greater PC board density.

#### Features

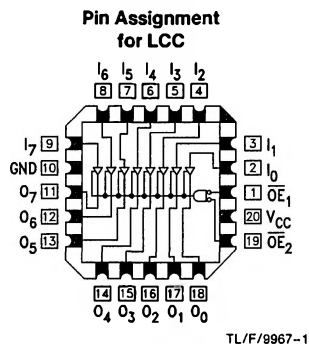
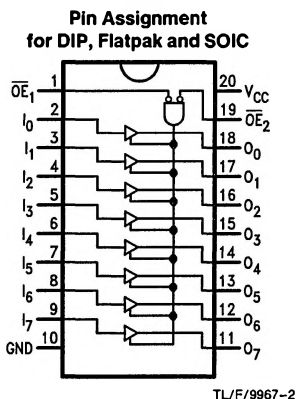
- TRI-STATE outputs
- Inputs and outputs opposite side of package, allowing easier interface to microprocessors
- Output source/sink 24 mA
- 'AC540 provides inverted outputs
- Standard Military Drawing (SMD)
  - 'AC541: 5962-88706

**Ordering Code:** See Section 8

#### Logic Symbol



#### Connection Diagrams



#### Truth Table

| Inputs          |                 |   | Outputs |
|-----------------|-----------------|---|---------|
| OE <sub>1</sub> | OE <sub>2</sub> | I |         |
| L               | L               | H | H       |
| H               | X               | X | Z       |
| X               | H               | X | Z       |
| L               | L               | L | L       |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance

## Absolute Maximum Rating (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                                                        |                          |
|------------------------------------------------------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ )                                            | –0.5V to +7.0V           |
| DC Input Diode Current ( $I_{IK}$ )                                    |                          |
| $V_I = -0.5V$                                                          | –20 mA                   |
| $V_I = V_{CC} + 0.5V$                                                  | +20 mA                   |
| DC Input Voltage ( $V_I$ )                                             | –0.5V to $V_{CC} + 0.5V$ |
| DC Output Diode Current ( $I_{OK}$ )                                   |                          |
| $V_O = -0.5V$                                                          | –20 mA                   |
| $V_O = V_{CC} + 0.5V$                                                  | +20 mA                   |
| DC Output Voltage ( $V_O$ )                                            | –0.5V to $V_{CC} + 0.5V$ |
| DC Output Source or Sink Current ( $I_O$ )                             | ±50 mA                   |
| DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ ) | ±50 mA                   |
| Storage Temperature ( $T_{STG}$ )                                      | –65°C to +150°C          |
| Junction Temperature ( $T_J$ )                                         |                          |
| CDIP                                                                   | 175°C                    |
| PDIP                                                                   | 140°C                    |

**Note 1:** Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT™ circuits outside databook specifications.

## Recommended Operating Conditions

|                                                 |                 |
|-------------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                     |                 |
| 'AC                                             | 2.0V to 6.0V    |
| 'ACT                                            | 4.5V to 5.5V    |
| Input Voltage ( $V_I$ )                         | 0V to $V_{CC}$  |
| Output Voltage ( $V_O$ )                        | 0V to $V_{CC}$  |
| Operating Temperature ( $T_A$ )                 |                 |
| 74AC/ACT                                        | –40°C to +85°C  |
| 54AC/ACT                                        | –55°C to +125°C |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                 |
| 'AC Devices                                     |                 |
| $V_{IN}$ from 30% to 70% of $V_{CC}$            |                 |
| $V_{CC}$ @ 3.3V, 4.5V, 5.5V                     | 125 mV/ns       |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                 |
| 'ACT Devices                                    |                 |
| $V_{IN}$ from 0.8V to 2.0V                      |                 |
| $V_{CC}$ @ 4.5V, 5.5V                           | 125 mV/ns       |

## DC Characteristics for 'AC Family Devices

| Symbol          | Parameter                         | V <sub>CC</sub><br>(V) | 74AC                   |                   | 54AC                                |  | 74AC                               |  | Units | Conditions                                                                                          |
|-----------------|-----------------------------------|------------------------|------------------------|-------------------|-------------------------------------|--|------------------------------------|--|-------|-----------------------------------------------------------------------------------------------------|
|                 |                                   |                        | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> =<br>–55°C to +125°C |  | T <sub>A</sub> =<br>–40°C to +85°C |  |       |                                                                                                     |
|                 |                                   |                        | Typ                    | Guaranteed Limits |                                     |  |                                    |  |       |                                                                                                     |
| V <sub>IH</sub> | Minimum High Level Input Voltage  | 3.0                    | 1.5                    | 2.1               | 2.1                                 |  | 2.1                                |  | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> – 0.1V                                                |
|                 |                                   | 4.5                    | 2.25                   | 3.15              | 3.15                                |  | 3.15                               |  |       |                                                                                                     |
|                 |                                   | 5.5                    | 2.75                   | 3.85              | 3.85                                |  | 3.85                               |  |       |                                                                                                     |
| V <sub>IL</sub> | Maximum Low Level Input Voltage   | 3.0                    | 1.5                    | 0.9               | 0.9                                 |  | 0.9                                |  | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> – 0.1V                                                |
|                 |                                   | 4.5                    | 2.25                   | 1.35              | 1.35                                |  | 1.35                               |  |       |                                                                                                     |
|                 |                                   | 5.5                    | 2.75                   | 1.65              | 1.65                                |  | 1.65                               |  |       |                                                                                                     |
| V <sub>OH</sub> | Minimum High Level Output Voltage | 3.0                    | 2.99                   | 2.9               | 2.9                                 |  | 2.9                                |  | V     | I <sub>OUT</sub> = –50 μA                                                                           |
|                 |                                   | 4.5                    | 4.49                   | 4.4               | 4.4                                 |  | 4.4                                |  |       |                                                                                                     |
|                 |                                   | 5.5                    | 5.49                   | 5.4               | 5.4                                 |  | 5.4                                |  |       |                                                                                                     |
|                 |                                   | 3.0                    |                        | 2.56              | 2.4                                 |  | 2.46                               |  | V     | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>–12 mA<br>I <sub>OH</sub> –24 mA<br>–24 mA |
|                 |                                   | 4.5                    |                        | 3.86              | 3.7                                 |  | 3.76                               |  |       |                                                                                                     |
|                 |                                   | 5.5                    |                        | 4.86              | 4.7                                 |  | 4.76                               |  |       |                                                                                                     |
| V <sub>OL</sub> | Maximum Low Level Output Voltage  | 3.0                    | 0.002                  | 0.1               | 0.1                                 |  | 0.1                                |  | V     | I <sub>OUT</sub> = 50 μA                                                                            |
|                 |                                   | 4.5                    | 0.001                  | 0.1               | 0.1                                 |  | 0.1                                |  |       |                                                                                                     |
|                 |                                   | 5.5                    | 0.001                  | 0.1               | 0.1                                 |  | 0.1                                |  |       |                                                                                                     |
|                 |                                   | 3.0                    |                        | 0.36              | 0.50                                |  | 0.44                               |  | V     | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>12 mA<br>I <sub>OL</sub> 24 mA<br>24 mA    |
|                 |                                   | 4.5                    |                        | 0.36              | 0.50                                |  | 0.44                               |  |       |                                                                                                     |
|                 |                                   | 5.5                    |                        | 0.36              | 0.50                                |  | 0.44                               |  |       |                                                                                                     |
| I <sub>IN</sub> | Maximum Input Leakage Current     | 5.5                    |                        | ±0.1              | ±1.0                                |  | ±1.0                               |  | μA    | V <sub>I</sub> = V <sub>CC</sub> , GND                                                              |

†Maximum test duration 2.0 ms, one output loaded at a time.

\*All outputs loaded; thresholds on input associated with output under test.

## DC Characteristics for 'AC Family Devices (Continued)

| Symbol           | Parameter                             | V <sub>CC</sub><br>(V) | 74AC                    |                   | 54AC                                  |  | 74AC                                 |  | Units | Conditions                                                                                                                                  |
|------------------|---------------------------------------|------------------------|-------------------------|-------------------|---------------------------------------|--|--------------------------------------|--|-------|---------------------------------------------------------------------------------------------------------------------------------------------|
|                  |                                       |                        | T <sub>A</sub> = + 25°C |                   | T <sub>A</sub> =<br>− 55°C to + 125°C |  | T <sub>A</sub> =<br>− 40°C to + 85°C |  |       |                                                                                                                                             |
|                  |                                       |                        | Typ                     | Guaranteed Limits |                                       |  |                                      |  |       |                                                                                                                                             |
| I <sub>OZ</sub>  | Maximum TRI-STATE®<br>Leakage Current | 5.5                    |                         | ± 0.5             | ± 10.0                                |  | ± 5.0                                |  | μA    | V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub><br>V <sub>I</sub> = V <sub>CC</sub> , GND<br>V <sub>O</sub> = V <sub>CC</sub> , GND |
| I <sub>OLD</sub> | †Minimum Dynamic<br>Output Current    | 5.5                    |                         |                   | 50                                    |  | 75                                   |  | mA    | V <sub>OLD</sub> = 1.65V Max                                                                                                                |
| I <sub>OHD</sub> |                                       | 5.5                    |                         |                   | − 50                                  |  | − 75                                 |  | mA    | V <sub>OHD</sub> = 3.85V Min                                                                                                                |
| I <sub>CC</sub>  | Maximum Quiescent<br>Supply Current   | 5.5                    |                         | 8.0               | 160.0                                 |  | 80.0                                 |  | μA    | V <sub>IN</sub> = V <sub>CC</sub><br>or GND                                                                                                 |

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

Note: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.

I<sub>CC</sub> for 54AC @ 25°C is identical to 74AC @ 25°C.

## AC Electrical Characteristics: See Section 2 for Waveforms

| Symbol | Parameter                           | Vcc*<br>(V) | 74AC                     |            |             | 54AC                                  |              | 74AC                                 |              | Units | Fig.<br>No. |
|--------|-------------------------------------|-------------|--------------------------|------------|-------------|---------------------------------------|--------------|--------------------------------------|--------------|-------|-------------|
|        |                                     |             | TA = +25°C<br>CL = 50 pF |            |             | TA = -55°C<br>to +125°C<br>CL = 50 pF |              | TA = -40°C<br>to +85°C<br>CL = 50 pF |              |       |             |
|        |                                     |             | Min                      | Typ        | Max         | Min                                   | Max          | Min                                  | Max          |       |             |
| tPLH   | Propagation Delay<br>Data to Output | 3.3<br>5.0  | 2.0<br>1.5               | 5.5<br>4.0 | 8.0<br>6.0  | 1.0<br>1.0                            | 10.0<br>7.0  | 1.5<br>1.0                           | 9.0<br>6.5   | ns    | 2-3, 4      |
| tPHL   | Propagation Delay<br>Data to Output | 3.3<br>5.0  | 2.0<br>1.5               | 5.5<br>4.0 | 8.0<br>6.0  | 1.0<br>1.0                            | 9.5<br>7.0   | 1.5<br>1.0                           | 8.5<br>6.5   | ns    | 2-3, 4      |
| tPZH   | Output Enable Time                  | 3.3<br>5.0  | 3.0<br>2.0               | 8.0<br>6.0 | 11.5<br>8.5 | 1.0<br>1.0                            | 13.5<br>10.0 | 3.0<br>1.5                           | 12.5<br>9.5  | ns    | 2-5         |
| tPZL   | Output Enable Time                  | 3.3<br>5.0  | 2.5<br>1.5               | 7.0<br>5.5 | 10.0<br>7.5 | 1.0<br>1.0                            | 12.5<br>9.0  | 2.5<br>1.0                           | 11.5<br>8.5  | ns    | 2-6         |
| tPHZ   | Output Disable Time                 | 3.3<br>5.0  | 3.5<br>2.0               | 9.0<br>7.0 | 12.5<br>9.5 | 1.0<br>1.0                            | 15.0<br>12.0 | 2.5<br>1.0                           | 14.0<br>10.5 | ns    | 2-5         |
| tPLZ   | Output Disable Time                 | 3.3<br>5.0  | 2.5<br>2.0               | 6.5<br>5.5 | 9.5<br>7.5  | 1.0<br>1.0                            | 11.0<br>9.0  | 2.0<br>1.0                           | 10.5<br>8.5  | ns    | 2-6         |

\*Voltage Range 3.3 is 3.3V ±0.3V

Voltage Range 5.0 is 5.0V ±0.5V

## Capacitance

| Symbol          | Parameter                        | Typ  | Units | Conditions             |
|-----------------|----------------------------------|------|-------|------------------------|
| C <sub>IN</sub> | Input Capacitance                | 4.5  | pF    | V <sub>CC</sub> = 5.0V |
| C <sub>PD</sub> | Power Dissipation<br>Capacitance | 30.0 | pF    | V <sub>CC</sub> = 5.0V |