

## 74ACQ241

### Octal Buffer/Line Driver with 3-STATE Outputs

#### General Description

The ACQ241 is an octal buffer and line driver designed to be employed as a memory address driver, clock driver and bus oriented transmitter or receiver which provides improved PC board density. The ACQ utilizes Fairchild FACT Quiet Series™ technology to guarantee quiet output switching and improved dynamic threshold performance. FACT Quiet Series features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

#### Features

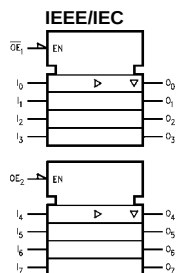
- $I_{CC}$  and  $I_{OZ}$  reduced by 50%
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Guaranteed pin-to-pin skew AC performance
- Improved latch-up immunity
- 3-STATE outputs drive bus lines or buffer memory address registers
- Outputs source/sink 24 mA
- Faster prop delays than the standard AC

#### Ordering Code:

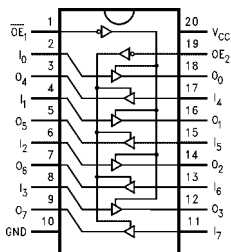
| Order Number | Package Number | Package Description                                                        |
|--------------|----------------|----------------------------------------------------------------------------|
| 74ACQ241SC   | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide |
| 74ACQ241PC   | N20A           | 20-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide     |

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

#### Logic Symbol



#### Connection Diagram



#### Pin Descriptions

| Pin Names                          | Description                  |
|------------------------------------|------------------------------|
| $\overline{OE}_1, \overline{OE}_2$ | 3-STATE Output Enable Inputs |
| $I_0-I_7$                          | Inputs                       |
| $O_0-O_7$                          | Outputs                      |

#### Truth Tables

| Inputs            |       | Outputs               |
|-------------------|-------|-----------------------|
| $\overline{OE}_1$ | $I_n$ | (Pins 12, 14, 16, 18) |
| L                 | L     | L                     |
| L                 | H     | H                     |
| H                 | X     | Z                     |

| Inputs            |       | Outputs           |
|-------------------|-------|-------------------|
| $\overline{OE}_2$ | $I_n$ | (Pins 3, 5, 7, 9) |
| H                 | L     | L                 |
| H                 | H     | H                 |
| H                 | X     | Z                 |

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

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**Absolute Maximum Ratings**(Note 1)

|                                          |                          |
|------------------------------------------|--------------------------|
| 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 ( $I_O$ )                | $\pm 50$ mA              |
| DC $V_{CC}$ or Ground Current            |                          |
| per Output Pin ( $I_{CC}$ or $I_{GND}$ ) | $\pm 50$ mA              |
| Storage Temperature ( $T_{STG}$ )        | -65°C to +150°C          |
| DC Latch-Up Source or                    |                          |
| Sink Current                             | $\pm 300$ mA             |
| Junction Temperature ( $T_J$ )           |                          |
| PDIP                                     | 140°C                    |

**Recommended Operating Conditions**

|                                             |                |
|---------------------------------------------|----------------|
| Supply Voltage ( $V_{CC}$ )                 | 2.0V to 6.0V   |
| Input Voltage ( $V_I$ )                     | 0V to $V_{CC}$ |
| Output Voltage ( $V_O$ )                    | 0V to $V_{CC}$ |
| Operating Temperature ( $T_A$ )             | -40°C to +85°C |
| Minimum Input Edge Rate $\Delta V/\Delta t$ | 125 mV/ns      |
| $V_{IN}$ from 30% to 70% of $V_{CC}$        |                |
| $V_{CC}$ @ 3.0V, 4.5V, 5.5V                 |                |

**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. Fairchild does not recommend operation of FACT™ circuits outside databook specifications.

**DC Electrical Characteristics**

| Symbol                      | Parameter                                       | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = −40°C to +85°C | Units | Conditions                                                                                                                                        |
|-----------------------------|-------------------------------------------------|------------------------|------------------------|-------------------|---------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------|
|                             |                                                 |                        | Typ                    | Guaranteed Limits |                                 |       |                                                                                                                                                   |
| V <sub>IH</sub>             | Minimum High Level<br>Input Voltage             | 3.0                    | 1.5                    | 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                            |       |                                                                                                                                                   |
|                             |                                                 | 5.5                    | 2.75                   | 3.85              | 3.85                            |       |                                                                                                                                                   |
| V <sub>IL</sub>             | Maximum Low Level<br>Input Voltage              | 3.0                    | 1.5                    | 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                            |       |                                                                                                                                                   |
|                             |                                                 | 5.5                    | 2.75                   | 1.65              | 1.65                            |       |                                                                                                                                                   |
| V <sub>OH</sub>             | Minimum High Level<br>Output Voltage            | 3.0                    | 2.99                   | 2.9               | 2.9                             | V     | I <sub>OUT</sub> = −50 μA                                                                                                                         |
|                             |                                                 | 4.5                    | 4.49                   | 4.4               | 4.4                             |       |                                                                                                                                                   |
|                             |                                                 | 5.5                    | 5.49                   | 5.4               | 5.4                             |       |                                                                                                                                                   |
|                             |                                                 | 3.0                    |                        | 2.56              | 2.46                            | V     | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OH</sub> = −12 mA<br>I <sub>OH</sub> = −24 mA<br>I <sub>OH</sub> = −24 mA (Note 2) |
|                             |                                                 | 4.5                    |                        | 3.86              | 3.76                            |       |                                                                                                                                                   |
|                             |                                                 | 5.5                    |                        | 4.86              | 4.76                            |       |                                                                                                                                                   |
| V <sub>OL</sub>             | Maximum Low Level<br>Output Voltage             | 3.0                    | 0.002                  | 0.1               | 0.1                             | V     | I <sub>OUT</sub> = 50 μA                                                                                                                          |
|                             |                                                 | 4.5                    | 0.001                  | 0.1               | 0.1                             |       |                                                                                                                                                   |
|                             |                                                 | 5.5                    | 0.001                  | 0.1               | 0.1                             |       |                                                                                                                                                   |
|                             |                                                 | 3.0                    |                        | 0.36              | 0.44                            | V     | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OL</sub> = 12 mA<br>I <sub>OL</sub> = 24 mA<br>I <sub>OL</sub> = 24 mA (Note 2)    |
|                             |                                                 | 4.5                    |                        | 0.36              | 0.44                            |       |                                                                                                                                                   |
|                             |                                                 | 5.5                    |                        | 0.36              | 0.44                            |       |                                                                                                                                                   |
| I <sub>IN</sub><br>(Note 4) | Maximum Input<br>Leakage Current                | 5.5                    |                        | ± 0.1             | ± 1.0                           | μA    | V <sub>I</sub> = V <sub>CC</sub> ,<br>GND                                                                                                         |
| I <sub>OLD</sub>            | Minimum Dynamic                                 | 5.5                    |                        |                   | 75                              | mA    | V <sub>OLD</sub> = 1.65V Max                                                                                                                      |
| I <sub>OHD</sub>            | Output Current (Note 3)                         | 5.5                    |                        |                   | −75                             | mA    | V <sub>OHD</sub> = 3.85V Min                                                                                                                      |
| I <sub>CC</sub><br>(Note 4) | Maximum Quiescent<br>Supply Current             | 5.5                    |                        | 4.0               | 40.0                            | μA    | V <sub>IN</sub> = V <sub>CC</sub><br>or GND                                                                                                       |
| I <sub>OZ</sub>             | Maximum 3-STATE<br>Leakage Current              | 5.5                    |                        | ± 0.25            | ± 2.5                           | 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       |
| V <sub>OLP</sub>            | Quiet Output<br>Maximum Dynamic V <sub>OL</sub> | 5.0                    | 1.1                    | 1.5               |                                 | V     | Figures 1, 2<br>(Note 5)(Note 6)                                                                                                                  |

**DC Electrical Characteristics** (Continued)

| Symbol           | Parameter                                       | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -40°C to +85°C | Units | Conditions                       |
|------------------|-------------------------------------------------|------------------------|------------------------|-------------------|---------------------------------|-------|----------------------------------|
|                  |                                                 |                        | Typ                    | Guaranteed Limits |                                 |       |                                  |
| V <sub>OLV</sub> | Quiet Output<br>Minimum Dynamic V <sub>OL</sub> | 5.0                    | -0.6                   | -1.2              |                                 | V     | Figures 1, 2<br>(Note 5)(Note 6) |
| V <sub>IHD</sub> | Minimum High Level<br>Dynamic Input Voltage     | 5.0                    | 3.1                    | 3.5               |                                 | V     | (Note 5)(Note 7)                 |
| V <sub>ILD</sub> | Maximum Low Level<br>Dynamic Input Voltage      | 5.0                    | 1.9                    | 1.5               |                                 | V     | (Note 5)(Note 7)                 |

**Note 2:** All outputs loaded; thresholds on input associated with output under test.

**Note 3:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 4:** 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>.

**Note 5:** DIP package.

**Note 6:** Max number of outputs defined as (n). Data Inputs are driven 0V to 5V. One output @ GND.

**Note 7:** Max number of Data Inputs (n) switching. n-1 Inputs switching 0V to 5V. Input-under-test switching: 5V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>).  
f = 1 MHz.

**AC Electrical Characteristics**

| Symbol            | Parameter                    | V <sub>CC</sub><br>(V)<br>(Note 8) | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |      | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Units |
|-------------------|------------------------------|------------------------------------|--------------------------------------------------|-----|------|-----------------------------------------------------------|------|-------|
|                   |                              |                                    | Min                                              | Typ | Max  | Min                                                       | Max  |       |
| t <sub>PHL</sub>  | Propagation Delay            | 3.3                                | 2.0                                              | 6.5 | 9.0  | 2.0                                                       | 9.5  | ns    |
| t <sub>PLH</sub>  | Data to Output               | 5.0                                | 1.5                                              | 4.5 | 6.0  | 1.5                                                       | 6.5  |       |
| t <sub>PZL</sub>  | Output Enable Time           | 3.3                                | 2.5                                              | 8.0 | 13.0 | 2.5                                                       | 13.5 | ns    |
| t <sub>PZH</sub>  |                              | 5.0                                | 1.5                                              | 5.5 | 8.5  | 1.5                                                       | 9.0  |       |
| t <sub>PHZ</sub>  | Output Disable Time          | 3.3                                | 1.0                                              | 8.5 | 14.5 | 1.0                                                       | 15.0 | ns    |
| t <sub>PLZ</sub>  |                              | 5.0                                | 1.0                                              | 5.5 | 9.5  | 1.0                                                       | 10.0 |       |
| t <sub>OSHL</sub> | Output to Output             | 3.3                                | 1.0                                              |     | 1.5  | 1.5                                                       |      | ns    |
| t <sub>OSLH</sub> | Skew Data to Output (Note 9) |                                    |                                                  |     |      |                                                           |      |       |

**Note 8:** Voltage Range 5.0 is 5.0V ± 0.5V. Voltage Range 3.3 is 3.3V ± 0.3V.

**Note 9:** Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

**Capacitance**

| Symbol          | Parameter                     | Typ | Units | Conditions             |
|-----------------|-------------------------------|-----|-------|------------------------|
| C <sub>IN</sub> | Input Capacitance             | 4.5 | pF    | V <sub>CC</sub> = OPEN |
| C <sub>PD</sub> | Power Dissipation Capacitance | 70  | pF    | V <sub>CC</sub> = 5.0V |

## FACT Noise Characteristics

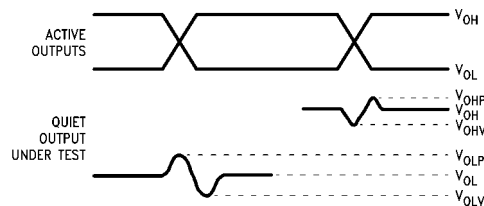
The setup of a noise characteristics measurement is critical to the accuracy and repeatability of the tests. The following is a brief description of the setup used to measure the noise characteristics of FACT.

### Equipment:

Hewlett Packard Model 8180A Word Generator  
PC-163A Test Fixture  
Tektronics Model 7854 Oscilloscope

### Procedure:

1. Verify Test Fixture Loading: Standard Load 50 pF, 500Ω.
2. Deskew the HFS generator so that no two channels have greater than 150 ps skew between them. This requires that the oscilloscope be deskewed first. It is important to deskew the HFS generator channels before testing. This will ensure that the outputs switch simultaneously.
3. Terminate all inputs and outputs to ensure proper loading of the outputs and that the input levels are at the correct voltage.
4. Set the HFS generator to toggle all but one output at a frequency of 1 MHz. Greater frequencies will increase DUT heating and effect the results of the measurement.
5. Set the word generator input levels at 0V LOW and 3V HIGH for ACT devices and 0V LOW and 5V HIGH for AC devices. Verify levels with an oscilloscope



**FIGURE 1. Quiet Output Noise Voltage Waveforms**

**Note 10:**  $V_{OHV}$  and  $V_{OLP}$  are measured with respect to ground reference.

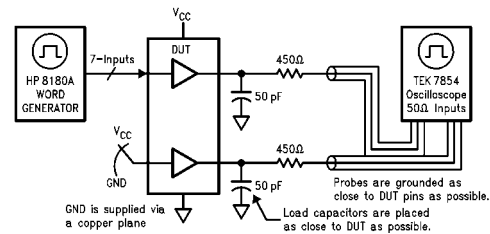
**Note 11:** Input pulses have the following characteristics:  $f = 1 \text{ MHz}$ ,  $t_r = 3 \text{ ns}$ ,  $t_f = 3 \text{ ns}$ , skew  $< 150 \text{ ps}$ .

$V_{OLP}/V_{OLV}$  and  $V_{OHP}/V_{OHV}$ :

- Determine the quiet output pin that demonstrates the greatest noise levels. The worst case pin will usually be the furthest from the ground pin. Monitor the output voltages using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- Measure  $V_{OLP}$  and  $V_{OLV}$  on the quiet output during the worst case transition for active and enable. Measure  $V_{OHP}$  and  $V_{OHV}$  on the quiet output during the worst case active and enable transition.
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

$V_{ILD}$  and  $V_{IHD}$ :

- Monitor one of the switching outputs using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- First increase the input LOW voltage level,  $V_{IL}$ , until the output begins to oscillate or steps out a min of 2 ns. Oscillation is defined as noise on the output LOW level that exceeds  $V_{IL}$  limits, or on output HIGH levels that exceed  $V_{IH}$  limits. The input LOW voltage level at which oscillation occurs is defined as  $V_{ILD}$ .
- Next decrease the input HIGH voltage level,  $V_{IH}$ , until the output begins to oscillate or steps out a min of 2 ns. Oscillation is defined as noise on the output LOW level that exceeds  $V_{IL}$  limits, or on output HIGH levels that exceed  $V_{IH}$  limits. The input HIGH voltage level at which oscillation occurs is defined as  $V_{IHD}$ .
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

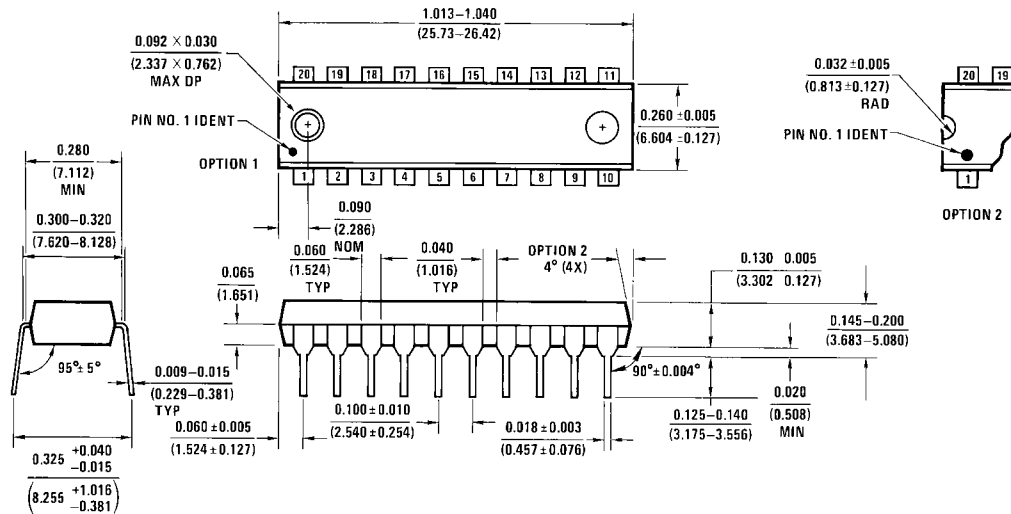


**FIGURE 2. Simultaneous Switching Test Circuit**

**Physical Dimensions** inches (millimeters) unless otherwise noted


20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide  
Package Number M20B

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



N20A (REV G)

20-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide  
Package Number N20A

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