

## FSTU32X384

### 20-Bit Low Power Bus Switch with -2V Undershoot Protection

#### General Description

The Fairchild Switch FSTU32X384 provides 20 bits of high-speed CMOS TTL-compatible bus switches. The low On Resistance of the switch allows inputs to be connected to outputs without adding propagation delay or generating additional ground bounce noise. The device is organized as four 5-bit switches with separate bus enable ( $\overline{OE}$ ) signals. When  $\overline{OE}$  is LOW, the switch is ON and Port A is connected to Port B. When  $\overline{OE}$  is HIGH, the switch is OPEN and a high-impedance state exists between the two ports.

The A and B Ports are protected against undershoot to support an extended range to 2.0V below ground. Fairchild's integrated Undershoot Hardened Circuit (UHC®) senses undershoot at the I/O and responds by preventing voltage differentials from developing and turning the switch on.

#### Features

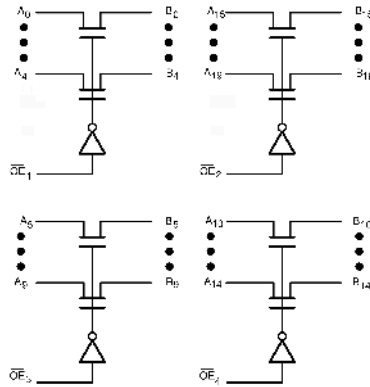
- 4Ω switch connection between two ports
- Minimal propagation delay through the switch
- Ultra low power with < 0.1 μA typical  $I_{CC}$
- Zero ground bounce in flow-through mode
- Control inputs compatible with TTL level
- See Application Note AN-5008 for details on FSTU - Undershoot Protected Fairchild Switch Family

#### Ordering Code:

| Order Number  | Package Number | Package Description  |
|---------------|----------------|--|
| FSTU32X384QSP | MQA48A         | 48-Lead Quarter Size Very Small Outline Package (QVSOP), JEDEC MO-154, 0.150" Wide |

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

#### Logic Diagram



UHC® is a registered trademark of Fairchild Semiconductor Corporation.

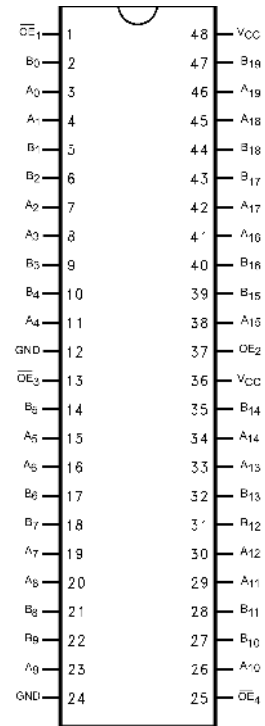
**Pin Descriptions**

| Pin Names         | Description       |
|-------------------|-------------------|
| $\overline{OE}_X$ | Bus Switch Enable |
| A                 | Bus A             |
| B                 | Bus B             |

**Truth Table**

| Inputs            | Inputs/Outputs |
|-------------------|----------------|
| $\overline{OE}_X$ | A, B           |
| L                 | A = B          |
| H                 | Z              |

**Connection Diagram**



**Absolute Maximum Ratings**(Note 1)

|   |                 |
|---|-----------------|
| Supply Voltage ( $V_{CC}$ )                       | -0.5V to +7.0V  |
| DC Switch Voltage ( $V_S$ )                       | -0.5V to +7.0V  |
| DC Input Voltage ( $V_{IN}$ ) (Note 2)            | -0.5V to +7.0V  |
| DC Input Diode Current ( $I_{IK}$ ) $V_{IN} < 0V$ | -50 mA          |
| DC Output ( $I_{OUT}$ ) Sink Current              | 128 mA          |
| DC $V_{CC}/GND$ Current ( $I_{CC}/I_{GND}$ )      | $\pm 100$ mA    |
| Storage Temperature Range ( $T_{STG}$ )           | -65°C to +150°C |

**Recommended Operating Conditions** (Note 3)

|  |                  |
|--|------------------|
| Power Supply Operating ( $V_{CC}$ )      | 4.0V to 5.5V     |
| Input Voltage ( $V_{IN}$ )               | 0V to 5.5V       |
| Output Voltage ( $V_{OUT}$ )             | 0V to 5.5V       |
| Input Rise and Fall Time ( $t_r, t_f$ )  |                  |
| Switch Control Input                     | 0 ns/V to 5 ns/V |
| Switch I/O                               | 0 ns/V to DC     |
| Free Air Operating Temperature ( $T_A$ ) | -40°C to +85°C   |

**Note 1:** The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:** The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

**Note 3:** Unused control inputs must be held HIGH or LOW. They may not float.

**DC Electrical Characteristics**

| Symbol          | Parameter                                  | $V_{CC}$<br>(V) | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ |                 |           | Units         | Condition   |
|-----------------|--|-----------------|---|-----------------|-----------|---------------|---|
|                 |  |                 | Min   | Typ<br>(Note 4) | Max       |               |   |
| $V_{IK}$        | Clamp Diode Voltage                        | 4.5             |   |                 | -1.2      | V             | $I_{IN} = -18\text{mA}$   |
| $V_{IH}$        | HIGH Level Input Voltage                   | 4.0 - 5.5       | 2.0   |                 |           | V             |   |
| $V_{IL}$        | LOW Level Input Voltage                    | 4.0 - 5.5       |   |                 | 0.8       | V             |   |
| $I_I$           | Input Leakage Current                      | 5.5             |   |                 | $\pm 1.0$ | $\mu\text{A}$ | $0 \leq V_{IN} \leq 5.5\text{V}$                                  |
|                 |  | 0               |   |                 | 10        |               | $V_{IN} = 5.5\text{V}$  |
| $I_{OZ}$        | OFF-STATE Leakage Current                  | 5.5             |   |                 | $\pm 1.0$ | $\mu\text{A}$ | $0 \leq A, B \leq V_{CC}$   |
| $R_{ON}$        | Switch On Resistance<br>(Note 5)           | 4.5             |   | 4               | 7         | $\Omega$      | $V_{IN} = 0\text{V}, I_{IN} = 64\text{mA}$                        |
|                 |  | 4.5             |   | 4               | 7         |               | $V_{IN} = 0\text{V}, I_{IN} = 30\text{mA}$                        |
|                 |  | 4.5             |   | 8               | 15        |               | $V_{IN} = 2.4\text{V}, I_{IN} = 15\text{mA}$                      |
|                 |  | 4.0             |   | 11              | 20        |               | $V_{IN} = 2.4\text{V}, I_{IN} = 15\text{mA}$                      |
| $I_{CC}$        | Quiescent Supply Current (Note 6)          | 5.5             |   |                 | 3         | $\mu\text{A}$ | $V_{IN} = V_{CC}$ or GND, $I_{OUT} = 0$                           |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input<br>(Note 7) | 5.5             |   |                 | 2.5       | mA            | One Input at 3.4V<br>Other Inputs at $V_{CC}$ or GND              |
| $V_{IKU}$       | Voltage Undershoot                         | 5.5             |   |                 | -2.0      | V             | $0.0\text{mA} \geq I_{IN} \geq 50\text{mA}$<br>$OE = 5.5\text{V}$ |

**Note 4:** All typical values are at  $V_{CC} = 5.0\text{V}$ ,  $T_A = 25^\circ\text{C}$ .

**Note 5:** Measured by voltage drop between A and B pin at indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (A or B) pins.

**Note 6:** Per  $V_{CC}$  pin.

**Note 7:** Per TTL driven input, control pins only.

## AC Electrical Characteristics

| Symbol             | Parameter   | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$<br>$C_L = 50\text{ pF, } R_U = R_D = 500\Omega$ |      |                        |      | Units | Conditions   | Figure Number |
|--------------------|---|---|------|------------------------|------|-------|--|---------------|
|                    |   | $V_{CC} = 4.5 - 5.5\text{V}$  |      | $V_{CC} = 4.0\text{V}$ |      |       |  |               |
|                    |   | Min   | Max  | Min                    | Max  |       |  |               |
| $t_{PHL}, t_{PLH}$ | Propagation Delay Bus to Bus (Note 8)                                   |   | 0.25 |                        | 0.25 | ns    | $V_I = \text{OPEN}$  | Figures 2, 3  |
| $t_{PZH}, t_{PZL}$ | Output Enable Time<br>$\overline{OE}_1, \overline{OE}_2$ to $A_n, B_n$  | 1.0   | 5.7  |                        | 6.2  | ns    | $V_I = 7\text{V}$ for $t_{PZL}$<br>$V_I = \text{OPEN}$ for $t_{PZH}$ | Figures 2, 3  |
| $t_{PHZ}, t_{PLZ}$ | Output Disable Time<br>$\overline{OE}_1, \overline{OE}_2$ to $A_n, B_n$ | 1.5   | 5.2  |                        | 5.5  | ns    | $I_I = 7\text{V}$ for $t_{PLZ}$<br>$V_I = \text{OPEN}$ for $t_{PHZ}$ | Figures 2, 3  |

**Note 8:** This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the typical On Resistance of the switch and the 50pF load capacitance, when driven by an ideal voltage the source (zero output impedance).

## Capacitance (Note 9)

| Symbol                 | Parameter                 | Typ | Max | Units | Conditions                            |
|------------------------|---------------------------|-----|-----|-------|---------------------------------------|
| $C_{IN}$               | Control Input Capacitance | 3   | 6   | pF    | $V_{CC} = 5.0\text{V}$                |
| $C_{I/O} (\text{OFF})$ | Input/Output Capacitance  | 5   | 13  | pF    | $V_{CC}, \overline{OE} = 5.0\text{V}$ |

**Note 9:** Capacitance is characterized but not tested.

## Undershoot Characteristic (Note 10)

| Symbol     | Parameter                        | Min | Typ            | Max | Units | Conditions |
|------------|----------------------------------|-----|----------------|-----|-------|------------|
| $V_{OUTU}$ | Output Voltage During Undershoot | 2.5 | $V_{OH} - 0.3$ |     | V     | Figure 1   |

**Note 10:** This test is intended to characterize the device's protective capabilities by maintaining output signal integrity during an input transient voltage undershoot event.

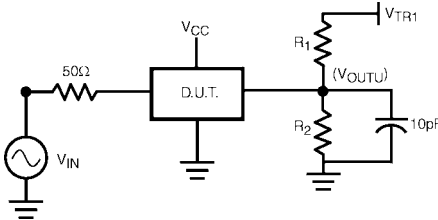
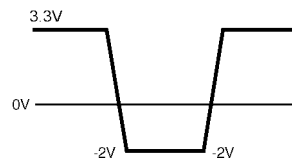


FIGURE 1.

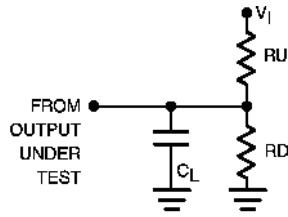
## Device Test Conditions

| Parameter   | Value        | Units    |
|-------------|--------------|----------|
| $V_{IN}$    | see Waveform | V        |
| $R_1 = R_2$ | 100K         | $\Omega$ |
| $V_{TRI}$   | 11.0         | V        |
| $V_{CC}$    | 5.5          | V        |

## Transient Input Voltage ( $V_{IN}$ ) Waveform



## AC Loading and Waveforms



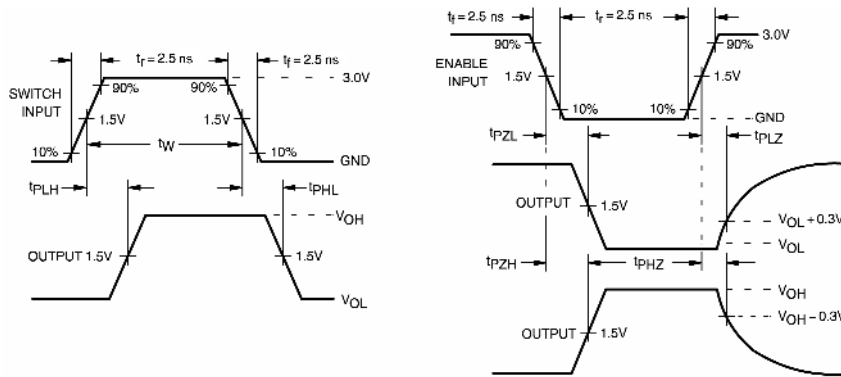
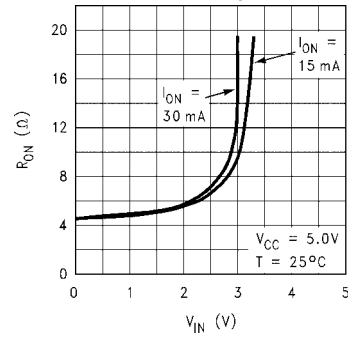
**Note:** Input driven by 50 Ω source terminated in 50 Ω

**Note:**  $C_L$  includes load and stray capacitance

**Note:** Input PRR = 1.0 MHz,  $t_{WV} = 500$  ns

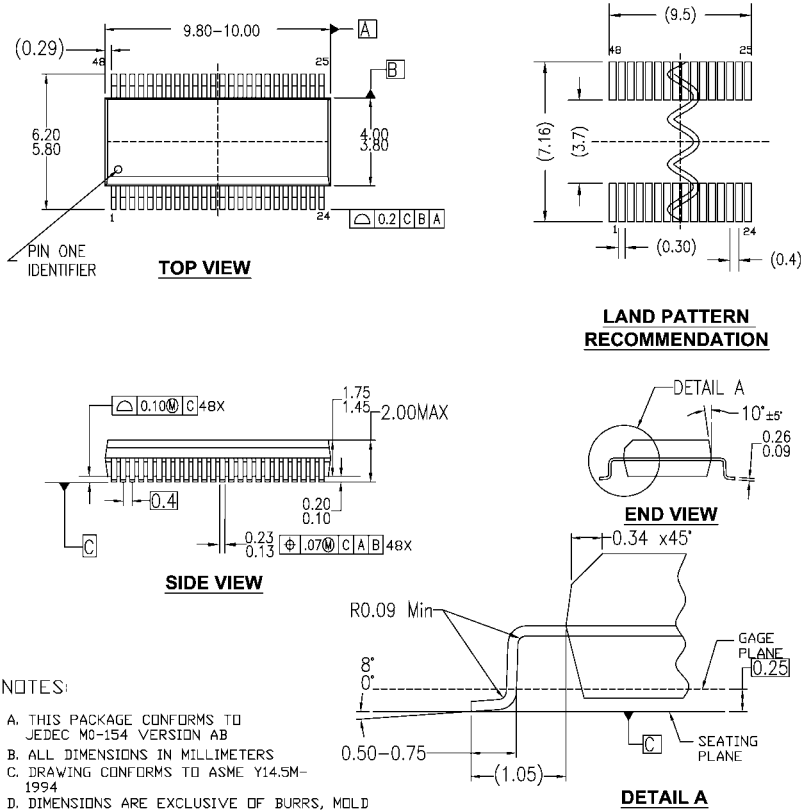
**FIGURE 2. AC Test Circuit**

**FSTU32X384  $V_{IN}$  vs.  $R_{ON}$  (Typ)**



**FIGURE 3. AC Waveforms**

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



- NOTES:
- A. THIS PACKAGE CONFORMS TO JEDEC MO-154 VERSION AB
  - B. ALL DIMENSIONS IN MILLIMETERS
  - C. DRAWING CONFORMS TO ASME Y14.5M-1994
  - D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

MQA48AREVA  
**48-Lead Quarter Size Very Small Outline Package (QVSOP), JEDEC MO-154, 0.150" Wide Package Number MQA48A**

**Technology Description**

The Fairchild Switch family derives from and embodies Fairchild's proven switch technology used for several years in its 74LVX3L384 (FSTU32X384) bus switch product.

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