

## FSTU3384

### 10-Bit Bus Switch with -2V Undershoot Protection

#### General Description

The Fairchild Switch FSTU3384 provides 10 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 generating additional ground bounce noise. Both the A Ports and the B Ports have "undershoot hardened" circuit protection to support an extended input range to 2.0V below ground. Fairchild's integrated Undershoot Hardened Circuit (UHC™) senses undershoot at the I/Os, and responds by preventing voltage differentials from developing and turning on the switch. The device is organized as two 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.

#### Features

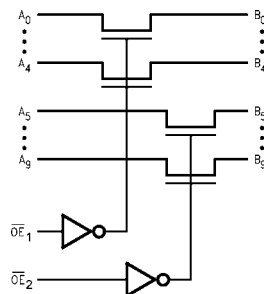
- 4 $\Omega$  switch connection between two ports
- Undershoot Hardened to -2.0V.
- Minimal propagation delay through the switch
- Low  $I_{CC}$
- Zero ground bounce in flow-through mode
- Control inputs compatible with TTL level
- See Applications Note AN-5008 for details.

#### Ordering Code:

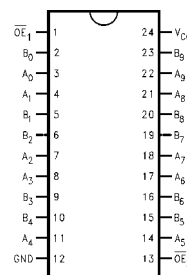
| Order Number | Package Number | Package Description                                                         |
|--------------|----------------|-----------------------------------------------------------------------------|
| FSTU3384WM   | M24B           | 24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide   |
| FSTU3384QSC  | MQA24          | 24-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150 Wide       |
| FSTU3384MTC  | MTC24          | 24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |

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

#### Logic Diagram



#### Connection Diagram



#### Pin Descriptions

| Pin Names                          | Description       |
|------------------------------------|-------------------|
| $\overline{OE}_1, \overline{OE}_2$ | Bus Switch Enable |
| A <sub>0</sub> -A <sub>9</sub>     | Bus A             |
| B <sub>0</sub> -B <sub>9</sub>     | Bus B             |

#### Truth Table

| $\overline{OE}_1$ | $\overline{OE}_2$ | B <sub>0</sub> -B <sub>4</sub> | B <sub>5</sub> -B <sub>9</sub> | Function   |
|-------------------|-------------------|--------------------------------|--------------------------------|------------|
| L                 | L                 | A <sub>0</sub> -A <sub>4</sub> | A <sub>5</sub> -A <sub>9</sub> | Connect    |
| L                 | H                 | A <sub>0</sub> -A <sub>4</sub> | HIGH-Z State                   | Connect    |
| H                 | L                 | HIGH-Z State                   | A <sub>5</sub> -A <sub>9</sub> | Connect    |
| H                 | H                 | HIGH-Z State                   | HIGH-Z State                   | Disconnect |

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**Absolute Maximum Ratings**(Note 1)

|                                                   |                 |
|---------------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                       | −0.5V to +7.0V  |
| DC Switch Voltage ( $V_S$ )                       | −2.0V 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 ( $I_{CC}/I_{GND}$ )     | +/- 100mA       |
| 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                       | 0nS/V to 5nS/V |
| Switch I/O                                 | 0nS/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 5) | 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             |                                                 |                 | ±1.0 | μA    | $0 \leq V_{IN} \leq 5.5V$                                            |
| $I_{OZ}$        | OFF-STATE Leakage Current        | 5.5             |                                                 |                 | ±1.0 | μA    | $0 \leq A, B \leq V_{CC}, V_{IN} = V_{IH}$                           |
| $R_{ON}$        | Switch On Resistance<br>(Note 4) | 4.5             |                                                 | 4               | 7    | Ω     | $V_S = 0V, I_{IN} = 64\text{ mA}$                                    |
|                 |                                  | 4.5             |                                                 | 4               | 7    | Ω     | $V_S = 0V, I_{IN} = 30\text{ mA}$                                    |
|                 |                                  | 4.5             |                                                 | 8               | 15   | Ω     | $V_S = 2.4V, I_{IN} = 15\text{ mA}$                                  |
|                 |                                  | 4.0             |                                                 | 11              | 20   | Ω     | $V_S = 2.4V, I_{IN} = 15\text{ mA}$                                  |
| $I_{CC}$        | Quiescent Supply Current         | 5.5             |                                                 |                 | 3    | μA    | $V_S = V_{CC}\text{ or GND}, I_{OUT} = 0$                            |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input   | 5.5             |                                                 |                 | 2.5  | mA    | $\overline{OE}$ input at 3.4V<br>Other inputs at $V_{CC}$ or GND     |
| $I_{BIAS}$      | Bias Pin Leakage Current         | 5.5             |                                                 |                 | ±1.0 | μA    | $\overline{OE} = 0V, B = 0V, BiasV = 5.5V$                           |
| $I_{OZU}$       | Switch Undershoot Current        | 5.5             |                                                 |                 | 100  | μA    | $I_{IN} = -20\text{ mA}, \overline{OE} = 5.5V, V_{OUT} \geq V_{IH}$  |
| $V_{IKU}$       | Voltage Undershoot               | 5.5             |                                                 |                 | −2.0 | V     | $0.0\text{ mA} \geq I_{IN} \geq -50\text{ mA}, \overline{OE} = 5.5V$ |

**Note 4:** 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 5:** All typical values are at  $V_{CC} = 5.0V, T_A = 25^\circ\text{C}$ .

## AC Electrical Characteristics

| Symbol                              | Parameter                                                                                   | T <sub>A</sub> = −40°C to +85°C<br>C <sub>L</sub> = 50 pF, R <sub>U</sub> = R <sub>D</sub> = 500Ω |      |                        |      | Units | Conditions                                                                             | Figure No.   |
|-------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------|------------------------|------|-------|----------------------------------------------------------------------------------------|--------------|
|                                     |                                                                                             | V <sub>CC</sub> = 4.5 – 5.5V                                                                      |      | V <sub>CC</sub> = 4.0V |      |       |                                                                                        |              |
|                                     |                                                                                             | Min                                                                                               | Max  | Min                    | Max  |       |                                                                                        |              |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Prop Delay Bus to Bus (Note 6)                                                              |                                                                                                   | 0.25 |                        | 0.25 | ns    | V <sub>I</sub> = OPEN                                                                  | Figures 1, 2 |
| t <sub>PZH</sub> , t <sub>PZL</sub> | Output Enable Time<br>OE <sub>1</sub> , OE <sub>2</sub> to A <sub>n</sub> , B <sub>n</sub>  | 1.0                                                                                               | 5.7  |                        | 6.2  | ns    | V <sub>I</sub> = 7V for t <sub>PZL</sub><br>V <sub>I</sub> = OPEN for t <sub>PZH</sub> | Figures 1, 2 |
| t <sub>PHZ</sub> , t <sub>PLZ</sub> | Output Disable Time<br>OE <sub>1</sub> , OE <sub>2</sub> to A <sub>n</sub> , B <sub>n</sub> | 1.5                                                                                               | 5.2  |                        | 5.5  | ns    | V <sub>I</sub> = 7V for t <sub>PLZ</sub><br>V <sub>I</sub> = OPEN for t <sub>PHZ</sub> | Figures 1, 2 |

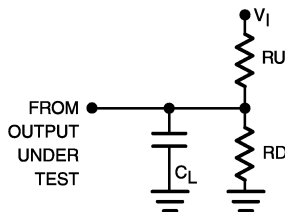
**Note 6:** This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the typical On resistance of the switch and the 50pF load capacitance, when driven by an ideal voltage the source (zero output impedance).

## Capacitance (Note 7)

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

**Note 7:** Capacitance is characterized but not tested.

## AC Loading and Waveforms



**Note:** Input driven by 50  $\Omega$  source terminated in 50  $\Omega$ ,  $R_U = R_D = 500\Omega$

**Note:**  $C_L$  includes load and stray capacitance,  $C_L = 50\text{ pF}$

**Note:** Input PRR = 1.0 MHz,  $t_W = 500\text{ ns}$

FIGURE 1. AC Test Circuit

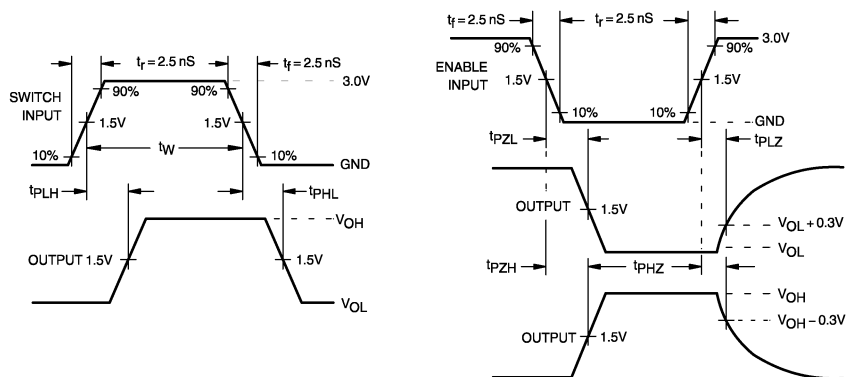


FIGURE 2. AC Waveforms

