FAIRCHILD SEMICONDUCTOR

May 2002
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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

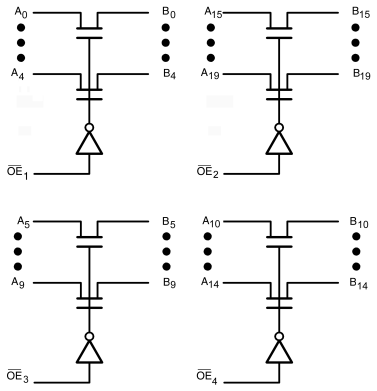
- 4Ω switch connection between two ports
- Minimal propagation delay through the switch
- Ultra low power with < 0.1 µA typical I_{CC}
- Zero ground bounce in flow-through mode
- Control inputs compatible with TTL level
- See Application Note AN-5008 for details on FSTU - Undershoot Protected Fairchild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

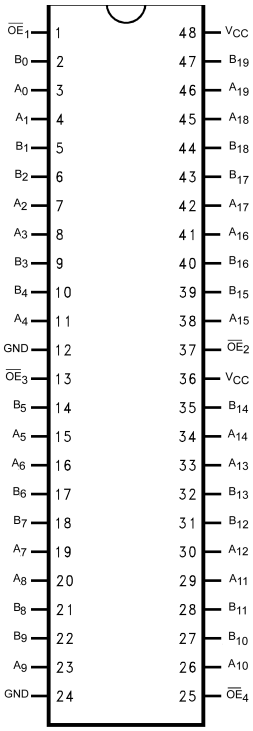
Pin Descriptions

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})	± 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} (V)	$T_A = -40°C$ to $+85°C$			Units	Condition
			Min	Typ (Note 4)	Max		
V_{IK}	Clamp Diode Voltage	4.5			−1.2	V	$I_{IN} = -18mA$
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	$0 \le V_{IN} \le 5.5V$
		0			10		$V_{IN} = 5.5V$
I_{OZ}	OFF-STATE Leakage Current	5.5			±1.0	µA	$0 \le A, B \le V_{CC}$
R_{ON}	Switch On Resistance (Note 5)	4.5		4	7	Ω	$V_{IN} = 0V$, $I_{IN} = 64$ mA
		4.5		4	7		$V_{IN} = 0V$, $I_{IN} = 30$ mA
		4.5		8	15		$V_{IN} = 2.4V$, $I_{IN} = 15$ mA
		4.0		11	20		$V_{IN} = 2.4V$, $I_{IN} = 15$ mA
I_{CC}	Quiescent Supply Current (Note 6)	5.5			3	µA	$V_{IN} = V_{CC}$ or GND, $I_{OUT} = 0$
ΔI_{CC}	Increase in I_{CC} per Input (Note 7)	5.5			2.5	mA	One Input at 3.4V Other Inputs at V_{CC} or GND
V_{IKU}	Voltage Undershoot	5.5			−2.0	V	0.0 mA ≥ I_{IN} ≥ 50 mA $\overline{OE} = 5.5V$

Note 4: All typical values are at $V_{CC} = 5.0V$, $T_A = 25°C$.

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	$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF, RU = RD = 500Ω				Units	Conditions	Figure Number
		$V_{CC} = 4.5 - 5.5V$		$V_{CC} = 4.0V$				
		Min	Max	Min	Max			
t_{PHL}, t_{PLH}	Propagation Delay Bus to Bus (Note 8)		0.25		0.25	ns	V_I = OPEN	Figures 2, 3
t_{PZH}, t_{PZL}	Output Enable Time $\overline{OE}_1$, $\overline{OE}_2$ to A_n, B_n	1.0	5.7		6.2	ns	V_I = 7V for t_{PZL} V_I = OPEN for t_{PZH}	Figures 2, 3
t_{PHZ}, t_{PLZ}	Output Disable Time $\overline{OE}_1$, $\overline{OE}_2$ to A_n, B_n	1.5	5.2		5.5	ns	I_I = 7V for t_{PLZ} V_I = 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} = 5.0V
$C_{I/O}$ (OFF)	Input/Output Capacitance	5	13	pF	V_{CC}, $\overline{OE}$ = 5.0V

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.

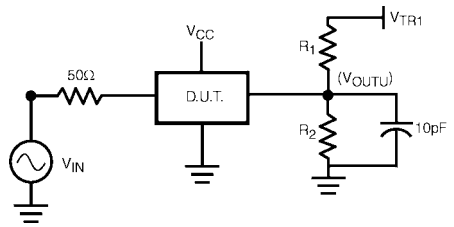
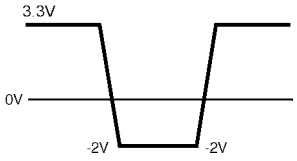


FIGURE 1.

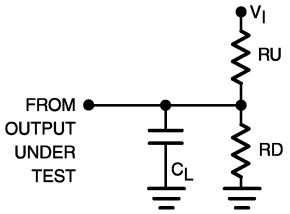
Device Test Conditions

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

Transient Input Voltage (V_{IN}) Waveform



AC Loading and Waveforms



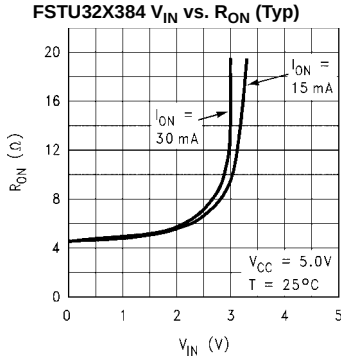
Note: Input driven by 50 Ω source terminated in 50 Ω

Note: C_L includes load and stray capacitance

Note: Input PRR = 1.0 MHz, t_W = 500 ns

FIGURE 2. AC Test Circuit

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



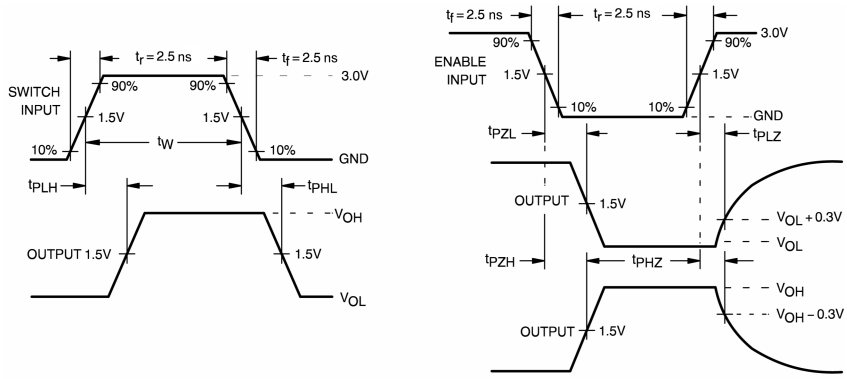
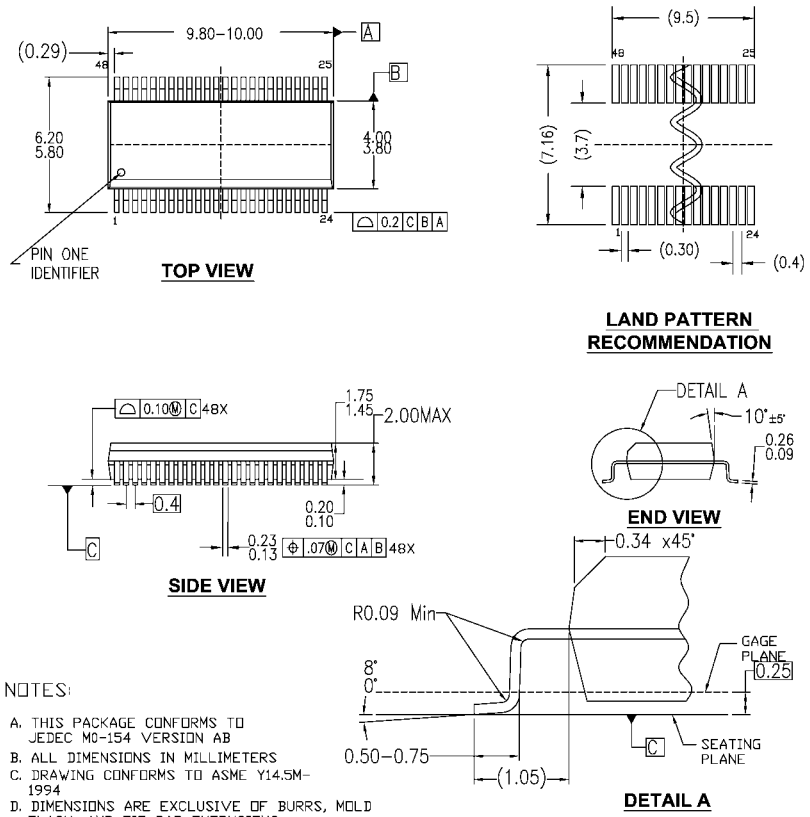


FIGURE 3. AC Waveforms

Physical Dimensions inches (millimeters) unless otherwise noted



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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