

June 2000 Revised April 2005

# FSTD16211

# 24-Bit Bus Switch with Level Shifting

### **General Description**

The Fairchild Switch FSTD16211 provides 24-bits of high-speed CMOS TTL-compatible bus switching. The low On Resistance of the switch allows inputs to be connected to outputs without adding propagation delay or generating additional ground bounce noise. A diode to  $V_{CC}$  has been integrated into the circuit to allow for level shifting between 5V inputs and 3.3V outputs.

The device is organized as a 12-bit or 24-bit bus switch. When  $\overline{\text{OE}}_1$  is LOW, the switch is ON and Port 1A is connected to Port 1B. When  $\overline{\text{OE}}_2$  is LOW, Port 2A is connected to Port 2B. When  $\overline{\text{OE}}_{1/2}$  is HIGH, a high impedance state exists between the A and B Ports.

### **Features**

- $\blacksquare$  4 $\Omega$  switch connection between two ports
- Voltage level shifting
- Minimal propagation delay through the switch
- Low I<sub>CC</sub>
- Zero bounce in flow-through mode
- Control inputs compatible with TTL level
- Also packaged in plastic Fine-Pitch Ball Grid Array (FBGA)

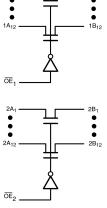
### **Ordering Code:**

Order Number	Package Number	Package Description
FSTD16211G (Note 1)(Note 2)		54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide [TAPE and REEL]
FSTD16211MTD (Note 2)	MTD56	56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Note 1: Ordering code "G" indicates Trays.

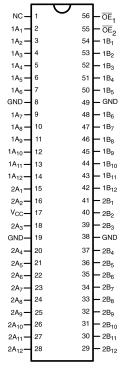
Note 2: Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

### **Logic Diagram**

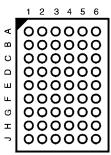


# **Connection Diagrams**

Pin Assignment for TSSOP



Pin Assignment for FBGA



(Top Thru View)

### **Pin Descriptions**

Pin Name	Description		
$\overline{OE}_1$ , $\overline{OE}_2$	Bus Switch Enables		
1A, 2A	Bus A		
1B, 2B	Bus B		
NC	No Connect		

# Pin Assignment for FBGA

	1	2	3	4	5	6
Α	1A <sub>2</sub>	1A <sub>1</sub>	NC	OE <sub>2</sub>	1B <sub>1</sub>	1B <sub>2</sub>
В	1A <sub>4</sub>	1A <sub>3</sub>	A <sub>3</sub> 1A <sub>7</sub> OE		OE <sub>1</sub> 1B <sub>3</sub>	
С	1A <sub>6</sub>	1A <sub>5</sub>	GND	1B <sub>7</sub>	1B <sub>5</sub>	1B <sub>6</sub>
D	1A <sub>10</sub>	1A <sub>9</sub>	1A <sub>8</sub>	1B <sub>8</sub>	1B <sub>9</sub>	1B <sub>10</sub>
Е	1A <sub>12</sub>	1A <sub>11</sub>	2A <sub>1</sub>	2B <sub>1</sub>	1B <sub>11</sub>	1B <sub>12</sub>
F	2A <sub>4</sub>	2A <sub>3</sub>	2A <sub>2</sub>	2B <sub>2</sub>	2B <sub>3</sub>	2B <sub>4</sub>
G	2A <sub>6</sub>	2A <sub>5</sub>	V <sub>CC</sub>	GND	2B <sub>5</sub>	2B <sub>6</sub>
Н	2A <sub>8</sub>	2A <sub>7</sub>	2A <sub>9</sub>	2B <sub>9</sub>	2B <sub>7</sub>	2B <sub>8</sub>
J	2A <sub>12</sub>	2A <sub>11</sub>	2A <sub>10</sub>	2B <sub>10</sub>	2B <sub>11</sub>	2B <sub>12</sub>

### **Truth Table**

Inp	uts	Inputs/Outputs			
OE <sub>1</sub>	OE <sub>2</sub>	1A, 1B	2A, 2B		
L	L	1A = 1B	2A = 2B		
L	Н	1A = 1B	Z		
Н	L	Z	2A = 2B		
Н	Н	Z	Z		

0V to 5.5V

### **Absolute Maximum Ratings**(Note 3)

 $\label{eq:Supply Voltage VCC} \mbox{Supply Voltage (V}_{\mbox{CC}}) & -0.5\mbox{V to } +7.0\mbox{V} \\ \mbox{DC Switch Voltage (V}_{\mbox{S}}) \mbox{ (Note 4)} & -0.5\mbox{V to } +7.0\mbox{V} \\ \mbox{}$ 

DC Switch Voltage ( $V_S$ ) (Note 4) -0.5V to +7.0VDC Input Control Pin Voltage ( $V_{IN}$ )(Note 5) -0.5V to +7.0VDC Input Diode Current ( $I_{IK}$ )  $V_{IN} < 0V$  -50 mA

DC Output (I<sub>OUT</sub>) 128 mA

DC V<sub>CC</sub>/GND Current (I<sub>CC</sub>/I<sub>GND</sub>) +/- 100 mA Storage Temperature Range (T<sub>STG</sub>) +65°C to +150 °C

# Recommended Operating Conditions (Note 6)

Power Supply Operating ( $V_{CC}$ ) 4.5V to 5.5V Input Voltage ( $V_{IN}$ ) 0V to 5.5V

Input Rise and Fall Time (t<sub>r</sub>, t<sub>f</sub>)

Output Voltage (V<sub>OUT</sub>)

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 3: 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 tables are not guaranteed at the absolute maximum rating. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 4:  $\mathsf{V}_\mathsf{S}$  is the voltage observed/applied at either A or B Ports across the switch.

**Note 5:** The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

Note 6: Unused control inputs must be held HIGH or LOW. They may not float

## **DC Electrical Characteristics**

	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = -40 °C to +85 °C				
Symbol			Min	Typ (Note 7)	Max	Units	Conditions
V <sub>IK</sub>	Clamp Diode Voltage	4.5			-1.2	V	I <sub>IN</sub> = -18 mA
V <sub>IH</sub>	HIGH Level Input Voltage	4.5-5.5	2.0			V	
V <sub>IL</sub>	LOW Level Input Voltage	4.5-5.5			0.8	V	
V <sub>OH</sub>	HIGH Level	4.5-5.5		See Figure 3	3	V	
I	Input Leakage Current	5.5			±1.0	μА	$0 \le V_{IN} \le 5.5V$
		0			10	μА	V <sub>IN</sub> = 5.5V
I <sub>OZ</sub>	OFF-STATE Leakage Current	5.5			±1.0	μА	$0 \le A, B \le V_{CC}$
R <sub>ON</sub>	Switch On Resistance	4.5		4	7	Ω	V <sub>IN</sub> = 0V, I <sub>IN</sub> = 64 mA
	(Note 8)	4.5		4	7	Ω	V <sub>IN</sub> = 0V, I <sub>IN</sub> = 30 mA
		4.5		35	50	Ω	V <sub>IN</sub> = 2.4V, I <sub>IN</sub> = 15 mA
Icc	Quiescent Supply Current	5.5			1.5	mA	OE <sub>1</sub> = OE <sub>2</sub> = GND
							$V_{IN} = V_{CC}$ or GND, $I_{OUT} = 0$
					10	μА	$OE_1 = OE_2 = V_{CC}$
							$V_{IN} = V_{CC}$ or GND, $I_{OUT} = 0$
I <sub>CCT</sub>	Increase in I <sub>CC</sub> per Control Input	5.5			2.5	mA	One Control Input at 3.4V
							Other Control Inputs at V <sub>CC</sub> or GND

Note 7: Typical values are at  $V_{CC} = 5.0V$  and  $T_A = +25$ °C

Note 8: Measured by the voltage drop between A and B pins at the indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (A or B) pins.

### **AC Electrical Characteristics**

Symbol	Parameter	$T_{A} = -40  ^{\circ}\text{C to } +85  ^{\circ}\text{C},$ $C_{L} = 50 \text{pF, RU} = \text{RD} = 500 \Omega$ $V_{CC} = 4.5 - 5.5 \text{V}$		Units	Conditions	Figure Number
		Min	Max			
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay Bus to Bus (Note 9)		0.25	ns	V <sub>I</sub> = OPEN	Figures 1, 2
t <sub>PZH</sub> , t <sub>PZL</sub>	Output Enable Time	1.5	5.5	ns	$V_I = 7V$ for $t_{PZL}$ $V_I = OPEN$ for $t_{PZH}$	Figures 1, 2
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time	1.5	6.5	ns	$V_I = 7V$ for $t_{PLZ}$ $V_I = OPEN$ for $t_{PHZ}$	Figures 1, 2

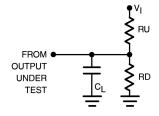
Note 9: This parameter is guaranteed by design but is not tested. The bus switch contributes no propagation delay other than the RC delay of the typical On Resistance of the switch and the 50pF load capacitance, when driven by an ideal voltage source (zero output impedance).

### Capacitance (Note 10)

	Symbol	Parameter	Тур	Max	Units	Conditions
C <sub>IN</sub>		Control Pin Input Capacitance	3.5		pF	V <sub>CC</sub> = 5.0V
C <sub>I/O</sub>	)	Input/Output Capacitance	5.5		pF	$V_{CC}$ , $\overline{OE} = 5.0V$

Note 10: T<sub>A</sub> = +25 °C, f = 1 MHz, Capacitance is characterized but not tested.

# **AC Loading and Waveforms**



Note: Input driven by  $50\Omega$  source terminated in  $50\Omega$ Note: CL includes load and stray capacitance Note: Input PRR = 1.0 MHz,  $t_W = 500$  ns

FIGURE 1. AC Test Circuit

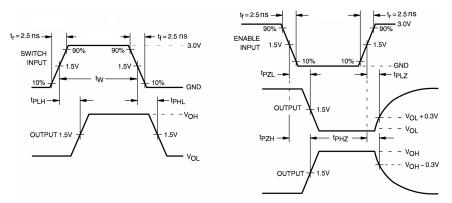
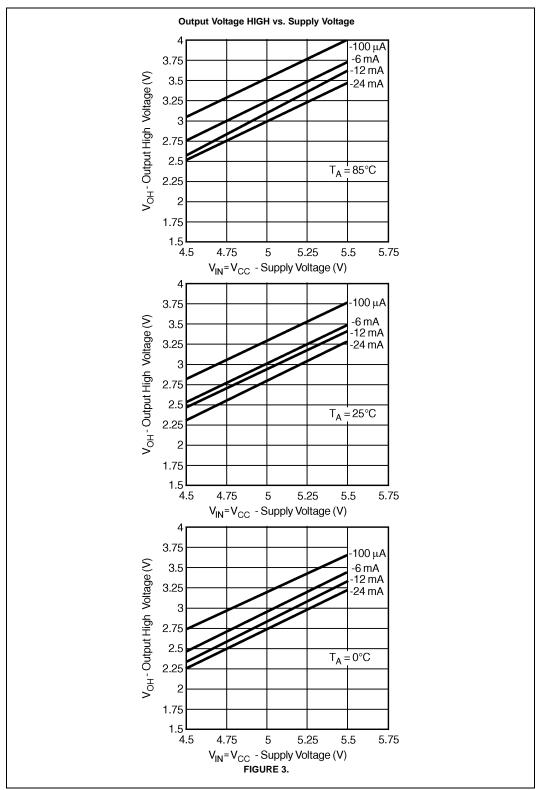
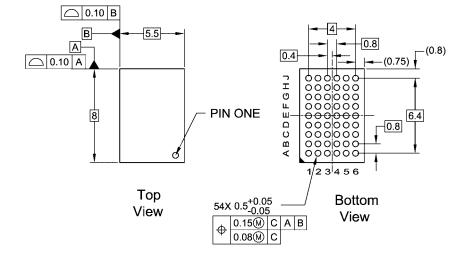
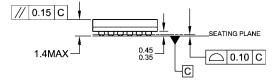


FIGURE 2. AC Waveforms



## Physical Dimensions inches (millimeters) unless otherwise noted



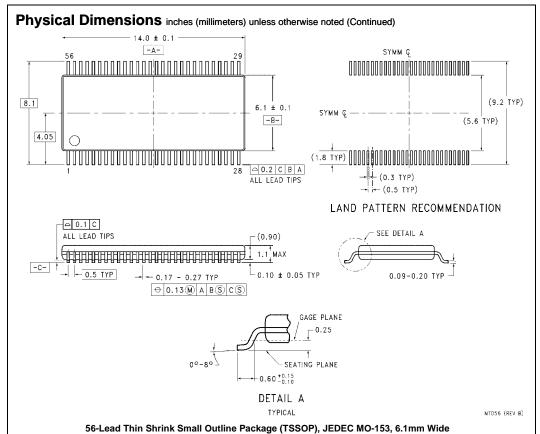


#### NOTES:

- A. THIS PACKAGE CONFORMS TO JEDEC M0-205
- **B. ALL DIMENSIONS IN MILLIMETERS**
- C. LAND PATTERN RECOMMENDATION: NSMD (Non Solder Mask Defined)
  .35MM DIA PADS WITH A SOLDERMASK OPENING OF .45MM CONCENTRIC TO PADS
  D. DRAWING CONFORMS TO ASME Y14.5M-1994

### BGA54ArevD

54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide Package Number BGA54A



### **Technology Description**

The Fairchild Switch family derives from and embodies Fairchild's proven switch technology used for several years in its 74LVX3L384 (FST3384) bus switch product.

Package Number MTD56

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