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FAIRCHILD SEMICONDUCTOR®

July 1997
Revised July 2002

# FST16211
# 24-Bit Bus Switch

## General Description

The Fairchild Switch FST16211 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.

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

## Features

- 4Ω switch connection between two ports
- Minimal propagation delay through the switch
- Low $I_{CC}$
- Zero bounce in flow-through mode
- Control inputs compatible with TTL level
- Also packaged in plastic Fine-Pitch Ball Grid Array (FBGA)

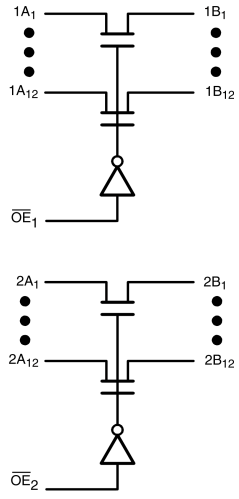
## Ordering Code:

| Order Number | Package Number | Package Description |
|---|---|---|
| FST16211G (Note 1)(Note 2) | BGA54A | 54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide |
| FST16211MEA (Note 2) | MS56A | 56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300" Wide |
| FST16211MTD (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

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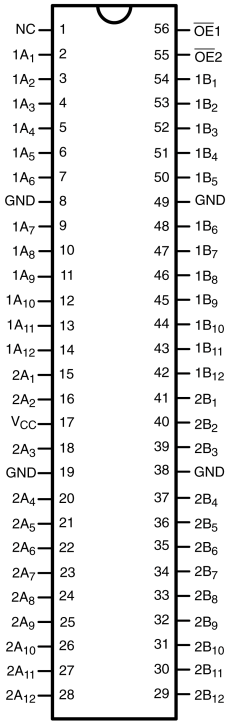
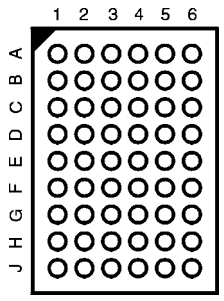
## Connection Diagrams

**Pin Assignment for SSOP and 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 |

## FBGA Pin Assignments

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **A** | $1A_2$ | $1A_1$ | NC | $OE_2$ | $1B_1$ | $1B_2$ |
| **B** | $1A_4$ | $1A_3$ | $1A_7$ | $OE_1$ | $1B_3$ | $1B_4$ |
| **C** | $1A_6$ | $1A_5$ | GND | $1B_7$ | $1B_5$ | $1B_6$ |
| **D** | $1A_{10}$ | $1A_9$ | $1A_8$ | $1B_8$ | $1B_9$ | $1B_{10}$ |
| **E** | $1A_{12}$ | $1A_{11}$ | $2A_1$ | $2B_1$ | $1B_{11}$ | $1B_{12}$ |
| **F** | $2A_4$ | $2A_3$ | $2A_2$ | $2B_2$ | $2B_3$ | $2B_4$ |
| **G** | $2A_6$ | $2A_5$ | $V_{CC}$ | GND | $2B_5$ | $2B_6$ |
| **H** | $2A_8$ | $2A_7$ | $2A_9$ | $2B_9$ | $2B_7$ | $2B_8$ |
| **J** | $2A_{12}$ | $2A_{11}$ | $2A_{10}$ | $2B_{10}$ | $2B_{11}$ | $2B_{12}$ |

## Truth Table

| Inputs | | Inputs/Outputs | |
|---|---|---|---|
| $\overline{OE}_1$ | $\overline{OE}_2$ | 1A, 1B | 2A, 2B |
| L | L | 1A = 1B | 2A = 2B |
| L | H | 1A = 1B | Z |
| H | L | Z | 2A = 2B |
| H | H | Z | Z |

## Absolute Maximum Ratings(Note 3)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.5V to +7.0V |
| DC Switch Voltage ($V_S$) (Note 4) | −0.5V to +7.0V |
| DC Input Voltage ($V_{IN}$) (Note 5) | −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 6)

| | |
|---|---|
| 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 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:** $V_S$ 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

| Symbol | Parameter | $V_{CC}$ (V) | $T_A$ = −40 °C to +85 °C | | | Units | Conditions |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ (Note 7) | Max | | |
| $V_{IK}$ | Clamp Diode Voltage | 4.5 | | | −1.2 | V | $I_{IN}$ = −18 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 ≤ $V_{IN}$ ≤ 5.5V |
| | | 0 | | | 10 | µA | $V_{IN}$ = 5.5V |
| $I_{OZ}$ | OFF-STATE Leakage Current | 5.5 | | | ±1.0 | µA | 0 ≤ A, B ≤ $V_{CC}$ |
| $R_{ON}$ | Switch On Resistance (Note 8) | 4.5 | | 4 | 7 | Ω | $V_{IN}$ = 0V, $I_{IN}$ = 64 mA |
| | | 4.5 | | 4 | 7 | Ω | $V_{IN}$ = 0V, $I_{IN}$ = 30 mA |
| | | 4.5 | | 8 | 12 | Ω | $V_{IN}$ = 2.4V, $I_{IN}$ = 15 mA |
| | | 4.0 | | 11 | 20 | Ω | $V_{IN}$ = 2.4V, $I_{IN}$ = 15 mA |
| $I_{CC}$ | Quiescent Supply Current | 5.5 | | | 3 | µA | $V_{IN}$ = $V_{CC}$ or GND, $I_{OUT}$ = 0 |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input | 5.5 | | | 2.5 | mA | One Input at 3.4V<br>Other Inputs at $V_{CC}$ 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 | $T_A = -40\,^\circ C$ to $+85\,^\circ C$, $C_L = 50pF$, $R_U = R_D = 500\Omega$ | | | | 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 9) | | 0.25 | | 0.25 | ns | $V_I$ = OPEN | Figures 1, 2 |
| $t_{PZH}$, $t_{PZL}$ | Output Enable Time | 1.5 | 6.0 | | 6.5 | ns | $V_I$ = 7V for $t_{PZL}$<br>$V_I$ = OPEN for $t_{PZH}$ | Figures 1, 2 |
| $t_{PHZ}$, $t_{PLZ}$ | Output Disable Time | 1.5 | 7.0 | | 7.2 | ns | $V_I$ = 7V for $t_{PLZ}$<br>$V_I$ = OPEN for $t_{PHZ}$ | Figures 1, 2 |

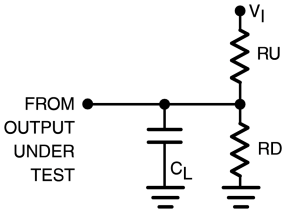
**Note 9:** This parameter is guaranteed by design but is not tested. The bus switch contributes no propagation delay other than the RC delay of the typical On Resistance of the switch and the 50pF load capacitance, when driven by an ideal voltage source (zero output impedance).

## Capacitance (Note 10)

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

**Note 10:** $T_A = +25°C$, f = 1 MHz, Capacitance is characterized but not tested.

## 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 1. AC Test Circuit**

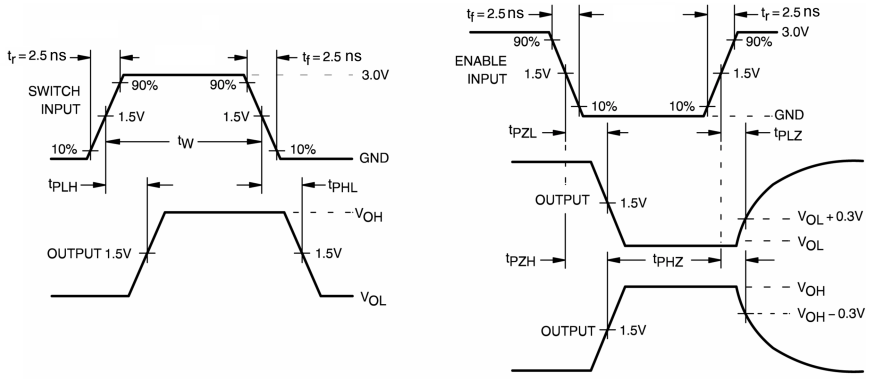
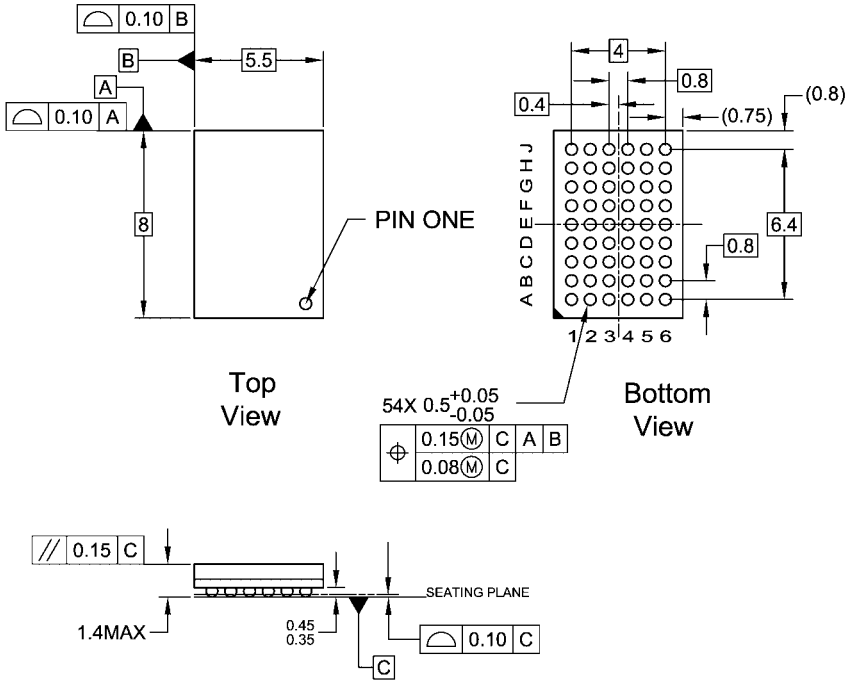



**FIGURE 2. AC Waveforms**

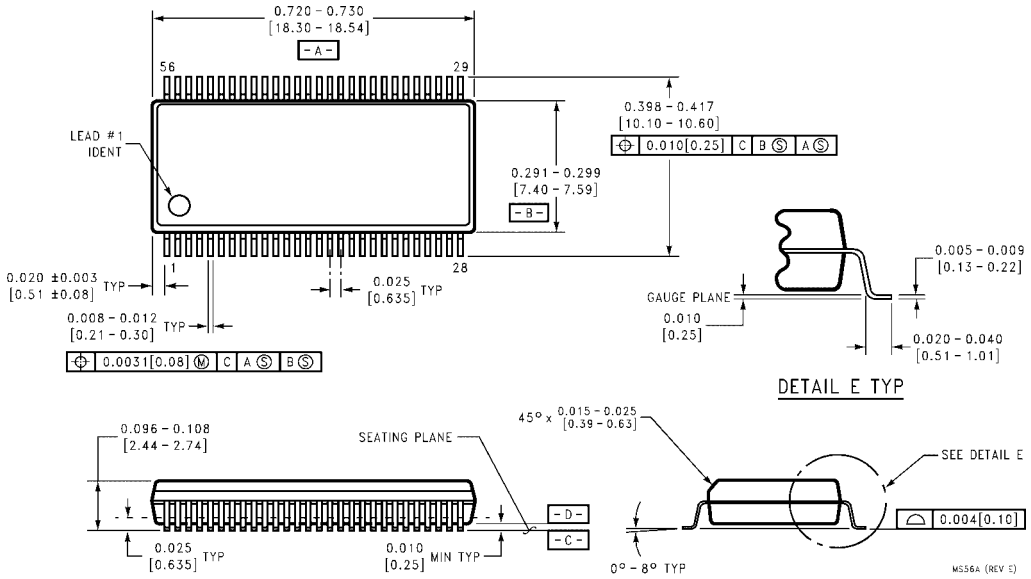



NOTES:

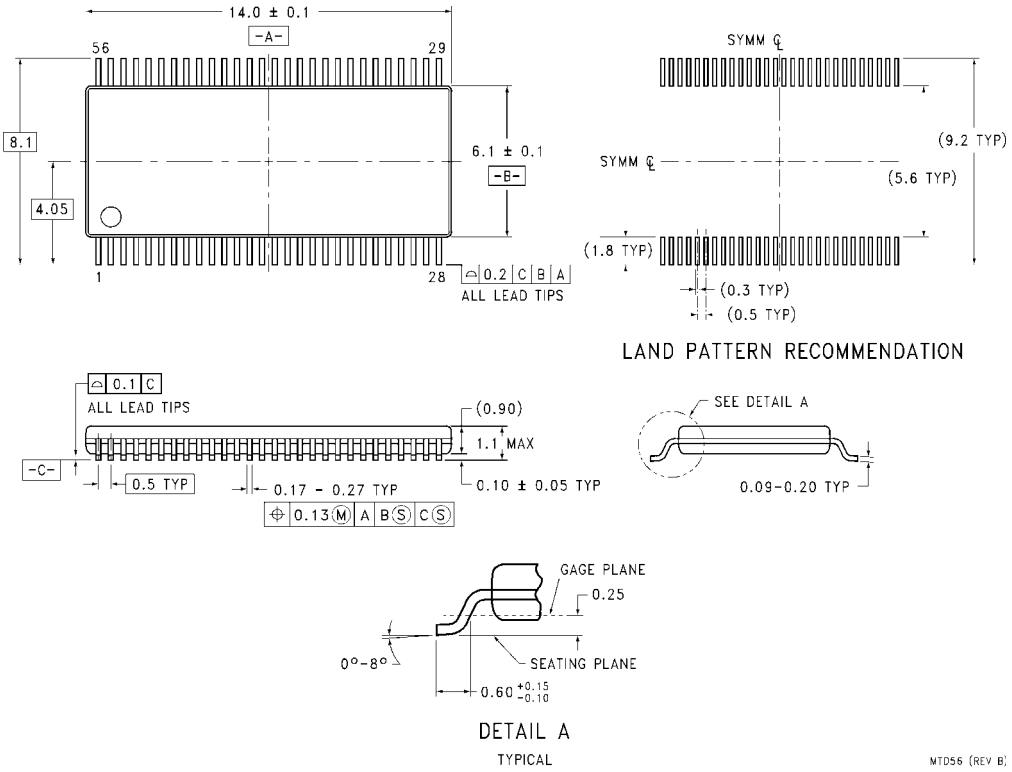
A. THIS PACKAGE CONFORMS TO JEDEC M0-205
B. ALL DIMENSIONS IN MILLIMETERS
C. LAND PATTERN RECOMMENDATION: NSMD (Non Solder Mask Defined)
.35MM DIA PADS WITH A SOLDERMASK OPENING OF .45MM CONCENTRIC TO PADS
D. DRAWING CONFORMS TO ASME Y14.5M-1994

BGA54ArevD

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




**56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300" Wide**
**Package Number MS56A**




**56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide**
**Package Number MTD56**

## 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.

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