

# 16-Bit to 32-Bit Multiplexer/ Demultiplexer Bus Switch with -2 V Undershoot Protection



ON Semiconductor®

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## FSTU32160

### General Description

The ON Semiconductor Switch FSTU32160 is a 16-bit to 32-bit highspeed CMOS TTL-compatible multiplexer/demultiplexer bus switch. 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 can be used in applications where two buses need to be addressed simultaneously. The FSTU32160 is designed so that the A Port demultiplexes into B<sub>1</sub> or B<sub>2</sub> or both. The A and B Ports have “undershoot hardened” circuit protection to support an extended range to 2.0 V below ground. The integrated Undershoot Hardened Circuit senses undershoot at the I/O’s, and responds by preventing voltage differentials from developing and turning on the switch.

Two select (S<sub>1</sub>, S<sub>2</sub>) inputs provide switch enable control. When S<sub>1</sub>, S<sub>2</sub> are HIGH, the device precharges the B Port to a selectable bias voltage (Bias V) to minimize live insertion noise.

### Features

- Undershoot hardened to -2 V (A and B Ports)
- Slower Output Enable Times prevent Signal Disruption
- 4 Ω Switch Connection between Two Ports
- Minimal Propagation Delay through the Switch
- Low I<sub>CC</sub>
- Zero Bounce in Flow-through Mode
- Control Inputs Compatible with TTL Level
- See Application Note AN-5008 for Details
- This Device is Pb-Free and is RoHS Compliant

### PIN DESCRIPTIONS

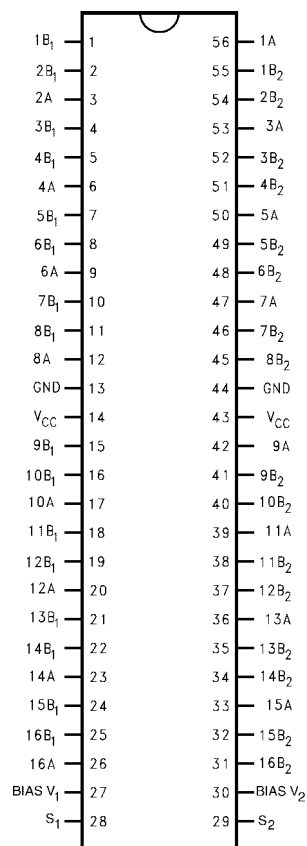
Pin Name	Description
S <sub>1</sub> , S <sub>2</sub>	Select Inputs
A	Bus A
B <sub>1</sub> , B <sub>2</sub>	Bus B

### TRUTH TABLE

Inputs		Function
S <sub>1</sub>	S <sub>2</sub>	
L	H	x A = x B <sub>1</sub>
H	L	x A = x B <sub>2</sub>
L	L	x A = x B <sub>1</sub> and x B <sub>2</sub>
H	H	x B <sub>1</sub> , x B <sub>2</sub> = BiasV

TSSOP56 14x6.1  
CASE 948BR

### CONNECTION DIAGRAM



### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

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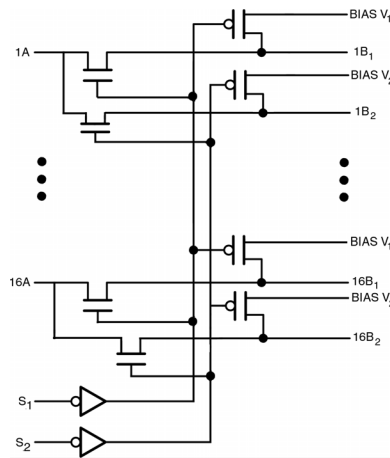


Figure 1. Logic Diagram

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Rating	Units
Supply Voltage	$V_{CC}$		-0.5 to 7.0	V
DC Switch Voltage	$V_S$	Note 1	-2.0 to 7.0	V
BiasV Voltage Range			-0.5 to 7.0	V
DC Input Control Pin Voltage	$V_{IN}$	Note 2	-0.5 to 7.0	V
DC Input Diode Current	$I_{IK}$	$V_{IN} < 0$ V	-50	mA
DC Output Current	$I_{OUT}$		128	mA
DC $V_{CC}/GND$ Current	$I_{CC}/I_{GND}$		$\pm 100$	mA
Storage Temperature Range	$T_{STG}$		-65 to 150	$^{\circ}C$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- $V_S$  is the voltage observed/applied at either the A or B Ports across the switch.
- The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

## RECOMMENDED OPERATING CONDITIONS (Note 3)

Parameter	Symbol	Conditions	Rating	Units
Power Supply Operating	$V_{CC}$		4.0 to 5.5	V
Precharge Supply	BiasV		1.5 to $V_{CC}$	V
Input Voltage	$V_{IN}$		0 to 5.5	V
Output Voltage	$V_{OUT}$		0 to 5.5	V
Input Rise and Fall Time	$t_r/t_f$	Switch Control Input	0 to 5	ns/V
		Switch I/O	0 to DC	
Free Air Operating Temperature	$T_A$		-40 to 85	$^{\circ}C$

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

- Unused control inputs must be held HIGH or LOW. They may not float.

## ORDERING INFORMATION

Part Number	Package	Shipping <sup>†</sup>
FSTU32160MTDX	TSSOP56 14x6.1, JEDEC MO-153, 6.1 mm Wide (Pb-Free)	1000 units / Tape & Reel

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D

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## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = -40 °C to +85 °C			Units	Conditions
			Min	Typ (Note 4)	Max		
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	4.0-5.5	2.0			V	
V <sub>IL</sub>	LOW Level Input Voltage	4.0-5.5			0.8	V	
I <sub>I</sub>	Input Leakage Current	5.5			±1.0	μA	0 ≤ V <sub>IN</sub> ≤ 5.5 V
		0			10	μA	V <sub>IN</sub> = 5.5 V
I <sub>O</sub>	Output Current	4.5	0.25			mA	BiasV = 2.4 V, S <sub>X</sub> = 2.0 V B <sub>X</sub> = 0
I <sub>OZH</sub> , I <sub>OZL</sub>	OFF-STATE Leakage Current	5.5			±1.0	μA	0 ≤ A, ≤ V <sub>CC</sub> , V BiasV <sub>1</sub> = BiasV <sub>2</sub> = 5.5 V
I <sub>OZH</sub> , I <sub>OZL</sub>	OFF-STATE Leakage Current	5.5			±1.0	μA	0 ≤ B, ≤ V <sub>CC</sub> , V BiasV <sub>1</sub> = BiasV <sub>2</sub> = FLOATING
R <sub>ON</sub>	Switch On Resistance (Note 5)	4.5		4	7	Ω	V <sub>IN</sub> = 0 V, I <sub>IN</sub> = 64 mA
		4.5		4	7	Ω	V <sub>IN</sub> = 0 V, I <sub>IN</sub> = 30 mA
		4.5		8	14	Ω	V <sub>IN</sub> = 2.4 V, I <sub>IN</sub> = 15 mA
		4.0		11	20	Ω	V <sub>IN</sub> = 2.4 V, I <sub>IN</sub> = 15 mA
I <sub>CC</sub>	Quiescent Supply Current	5.5			3	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND, I <sub>OUT</sub> = 0
Δ I <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	5.5			2.5	mA	One input at 3.4 V Other inputs at V <sub>CC</sub> or GND
I <sub>BIAS</sub>	Bias Pin Leakage Current	5.5			±1.0	μA	S <sub>1</sub> , S <sub>2</sub> = 0 V B <sub>X</sub> = 0 V, BiasV <sub>X</sub> = 5.5 V
V <sub>IKU</sub>	Voltage Undershoot	5.5			-2.0	V	0.0 mA ≥ I <sub>IN</sub> ≥ -50 mA S <sub>1</sub> , S <sub>2</sub> = 5.5 V

4. Typical values are at V<sub>CC</sub> = 5.0 V and T<sub>A</sub> = +25 °C

5. 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 <sub>A</sub> = -40 °C to +85 °C, C <sub>L</sub> = 50 pF, R <sub>U</sub> = R <sub>D</sub> = 500 Ω				Units	Conditions	Figure No.
		V <sub>CC</sub> = 4.5 - 5.5 V		V <sub>CC</sub> = 4.0 V				
		Min	Max	Min	Max			
t <sub>PHL</sub> , t <sub>PLH</sub>	A or B, to B or A (Note 6)		0.25		0.25	ns	V <sub>I</sub> = OPEN	Figures 4, 5
t <sub>PZH</sub>	Output Enable Time, S to A, B	7.0	30.0		35.0	ns	V <sub>I</sub> = OPEN for t <sub>PZH</sub> BiasV = GND	Figures 4, 5
t <sub>PZL</sub>	Output Enable Time, S to A, B	7.0	30.0		35.0	ns	V <sub>I</sub> = 7 V for t <sub>PZL</sub> BiasV = 3 V	Figures 4, 5
t <sub>PHZ</sub>	Output Disable Time, S to A, B	1.0	6.9		7.3	ns	V <sub>I</sub> = OPEN for t <sub>PHZ</sub> BiasV = GND	Figures 4, 5
t <sub>PLZ</sub>	Output Disable Time, S to A, B	1.0	7.7		7.7	ns	V <sub>I</sub> = 7 V for t <sub>PLZ</sub> BiasV = 3 V	Figures 4, 5

6. 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 50 pF load capacitance, when driven by an ideal voltage source (zero output impedance).

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## CAPACITANCE (Note 7)

Symbol	Parameter	Typ	Max	Units	Conditions
$C_{IN}$	Control pin Input Capacitance	4		pF	$V_{CC} = 5.0\text{ V}$
$C_{I/O\ OFF}$	Input/Output Capacitance "OFF State"	8		pF	$V_{CC} = 5.0\text{ V}$ , Switch OFF

7.  $T_A = +25^\circ\text{C}$ ,  $f = 1\text{ MHz}$ , Capacitance is characterized but not tested.

## UNDERSHOOT CHARACTERISTIC (Note 8)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$V_{OUTU}$	Output Voltage During Undershoot	2.5	$V_{OH} - 0.3$		V	Figure 2

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

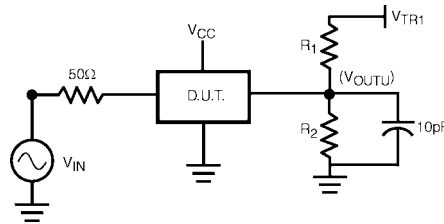


Figure 2.

## 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

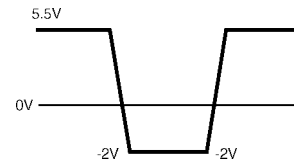
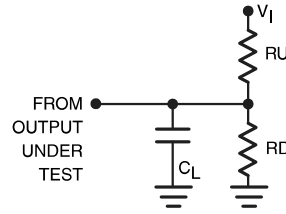


Figure 3. Transient Input Voltage ( $V_{IN}$ ) Waveform

AC Loading and Waveforms



Notes:

Input driven by 50 Ω source terminated in 50 Ω.  
 $C_L$  includes load and stray capacitance,  $C_L = 50$  pF  
 Input PRR = 1.0 MHz,  $t_W = 500$  ns

Figure 4. AC Test Circuit

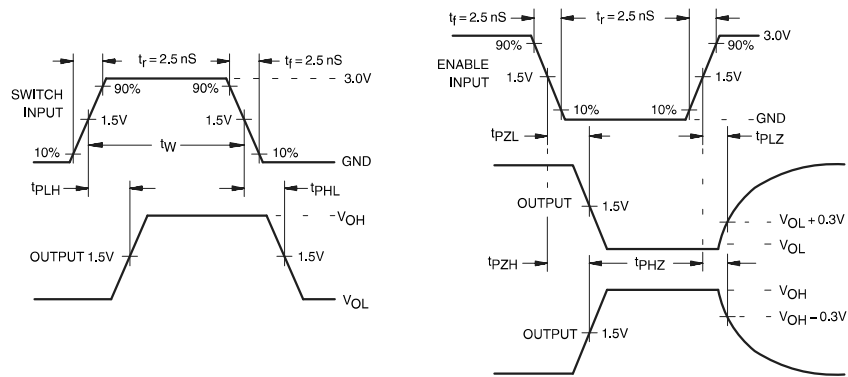


Figure 5. AC Waveforms

# MECHANICAL CASE OUTLINE

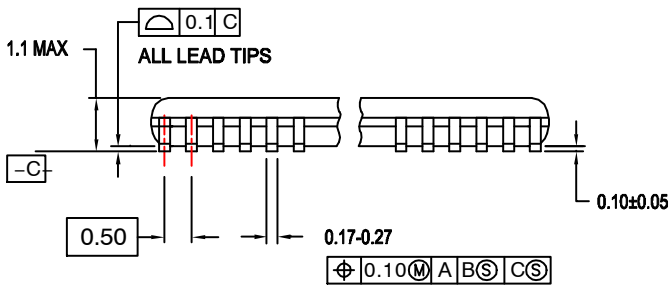
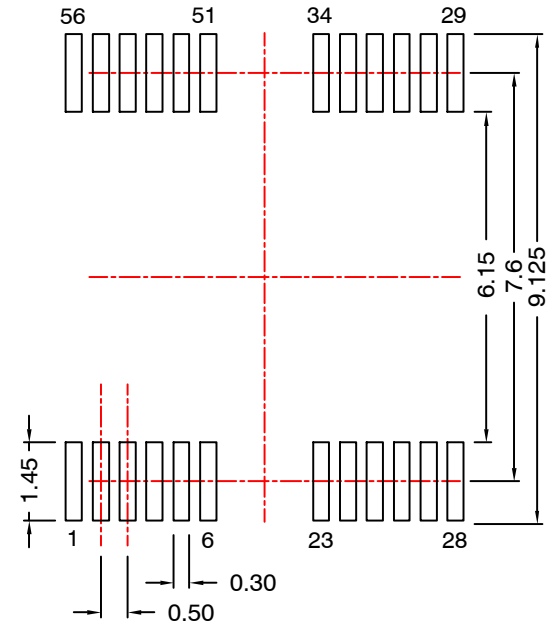
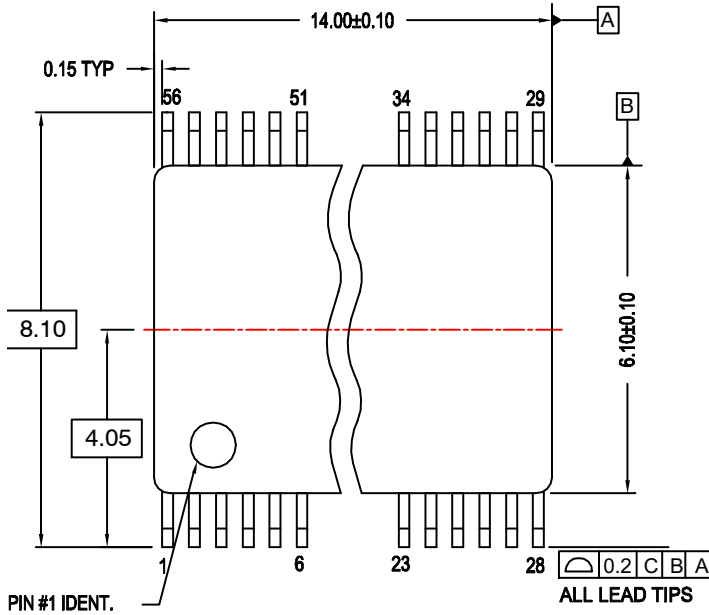
## PACKAGE DIMENSIONS

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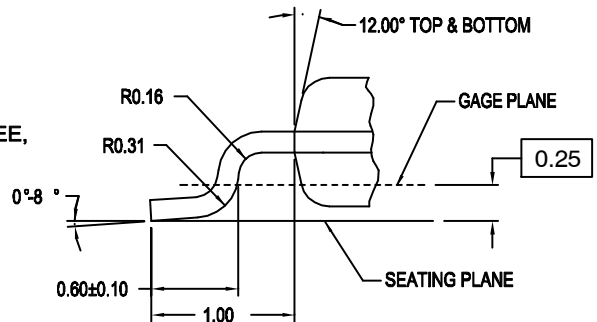
TSSOP56 14x6.1  
CASE 948BR  
ISSUE O

DATE 30 SEP 2016



**NOTES:**

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION EE, REF NOTE 6, DATE 10/97.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.



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