

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 B₁ or B₂ 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 (S₁, S₂) inputs provide switch enable control. When S₁, S₂ 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_{CC}
- 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

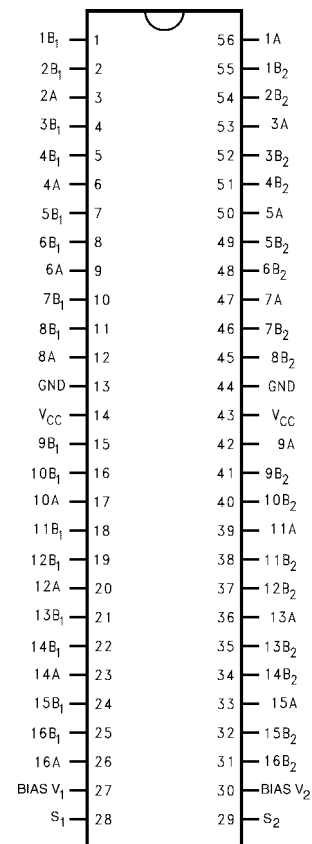
Pin Name	Description
S ₁ , S ₂	Select Inputs
A	Bus A
B ₁ , B ₂	Bus B

TRUTH TABLE

Inputs		Function
S ₁	S ₂	
L	H	x A = x B ₁
H	L	x A = x B ₂
L	L	x A = x B ₁ and x B ₂
H	H	x B ₁ , x B ₂ = 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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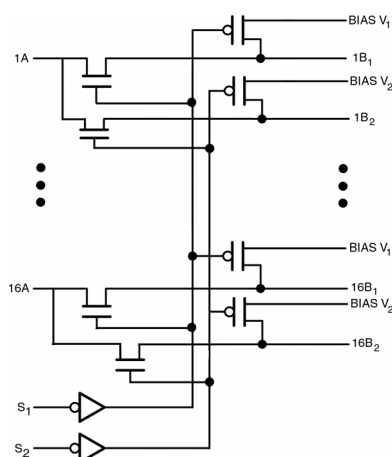


Figure 1. Logic Diagram

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}		± 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 [†]
FSTU32160MTDX	TSSOP56 14x6.1, JEDEC MO-153, 6.1 mm Wide (Pb-Free)	1000 units / Tape & Reel

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

4. Typical values are at V_{CC} = 5.0 V and T_A = +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 _A = -40 °C to +85 °C, C _L = 50 pF, R _U = R _D = 500 Ω				Units	Conditions	Figure No.
		V _{CC} = 4.5 - 5.5 V		V _{CC} = 4.0 V				
		Min	Max	Min	Max			
t _{PHL} , t _{PLH}	A or B, to B or A (Note 6)		0.25		0.25	ns	V _I = OPEN	Figures 4, 5
t _{PZH}	Output Enable Time, S to A, B	7.0	30.0		35.0	ns	V _I = OPEN for t _{PZH} BiasV = GND	Figures 4, 5
t _{PZL}	Output Enable Time, S to A, B	7.0	30.0		35.0	ns	V _I = 7 V for t _{PZL} BiasV = 3 V	Figures 4, 5
t _{PHZ}	Output Disable Time, S to A, B	1.0	6.9		7.3	ns	V _I = OPEN for t _{PHZ} BiasV = GND	Figures 4, 5
t _{PLZ}	Output Disable Time, S to A, B	1.0	7.7		7.7	ns	V _I = 7 V for t _{PLZ} 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.

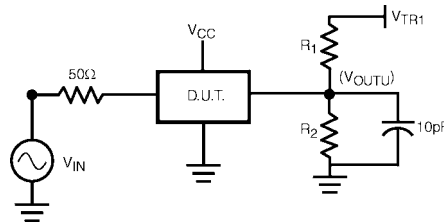


Figure 2.

DEVICE TEST CONDITIONS

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

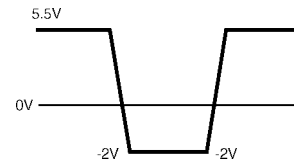
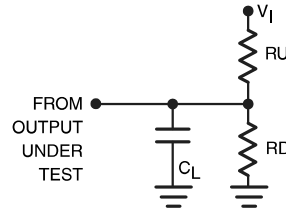


Figure 3. Transient Input Voltage (V_{IN}) Waveform

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

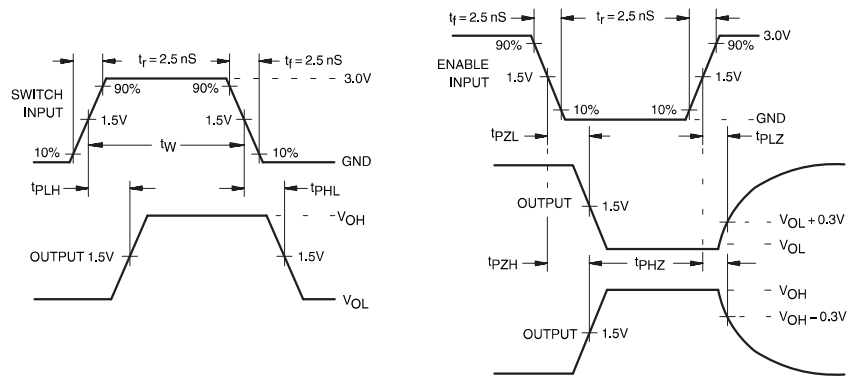


Figure 5. AC Waveforms

MECHANICAL CASE OUTLINE

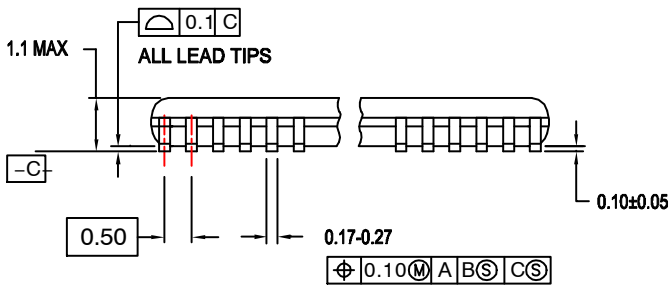
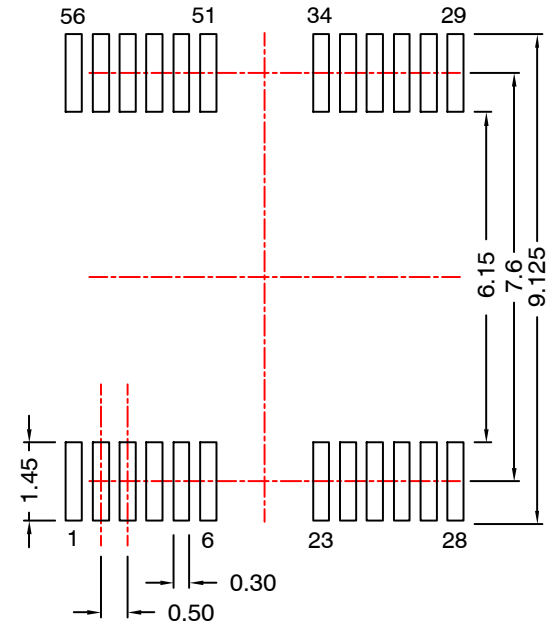
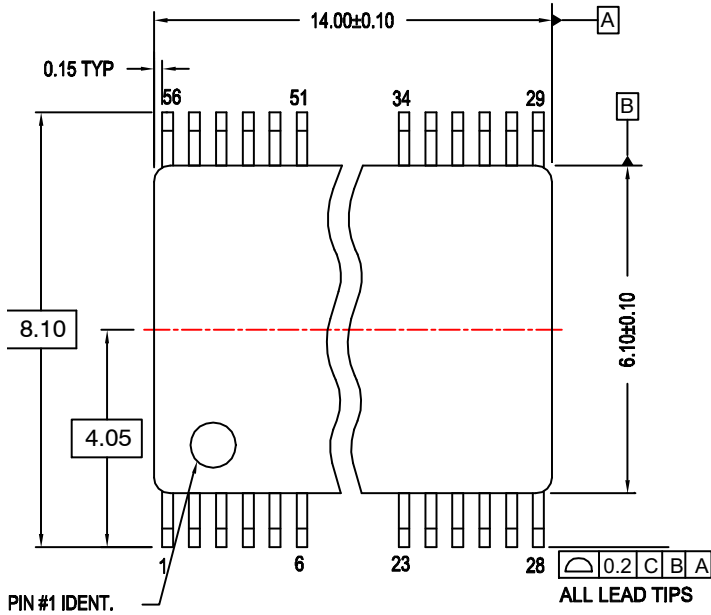
PACKAGE DIMENSIONS

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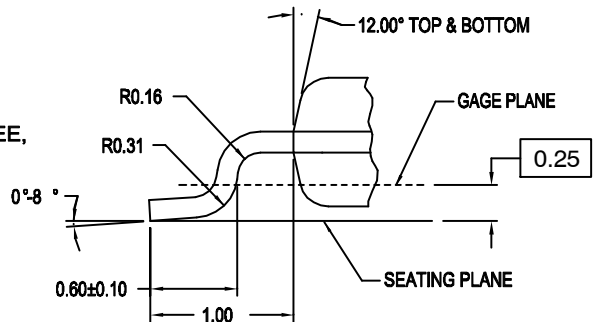
TSSOP56 14x6.1
CASE 948BR
ISSUE O

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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