Low-Voltage SPDT Analog Switch or 2:1 Multiplexer/ De-multiplexer Bus Switch

NC7SBU3157, FSAU3157

General Description

The NC7SBU3157 / FSAU3157 is a high–performance, single–pole / double–throw (SPDT) analog switch or 2:1 multiplexer / de–multiplexer bus switch.

The device is fabricated with advanced sub-micron CMOS technology to achieve high-speed enable and disable times and low on resistance. The break-beforemake select circuitry prevents disruption of signals on the B port due to both switches temporarily being enabled during select pin switching. The device is specified to operate over the 1.65 to 5.5 V $V_{\rm CC}$ operating range. The control input tolerates voltages up to 5.5V, independent of the $V_{\rm CC}$ operating range.

ON Semiconductor integrated Undershoot Hardened Circuit senses undershoot at the I/Os, and responds by preventing voltage differentials from developing and turning the switch on.

Features

- Analog and Digital Applications
- Space-saving, SC70 6-lead, Surface-mount Package
- Low On Resistance: $<10~\Omega$ on typical at 3.3 V V_{CC}
- Broad V_{CC} Operating Range: 1.65 V to 5.5 V
- Rail-to-rail Signal Handling
- Power-down, High-impedance Control Input
- Over-voltage Tolerance of Control Input to 7.0 V
- Break-before-make Enable Circuitry
- 250 MHz, 3 dB Bandwidth
- This Device is Pb-Free and is RoHS Compliant

FUNCTION TABLE

Input (S)	Function
Logic Level Low	B ₀ Connected to A
Logic Level High	B ₁ Connected to A

PIN DESCRIPTIONS

Pin Names	Description
A, B ₀ , B ₁	Data Ports
S	Control Input



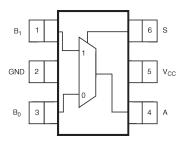
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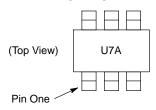
SC-88 (SC-70 6 Lead), 1.25x2 CASE 419AD

CONNECTION DIAGRAM



Pin Assignment SC-70

MARKING DIAGRAM



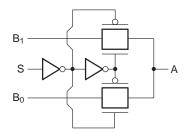
NOTE:

Orientation of top mark determines pin one location. Read the top mark left to right and pin one is the lower left pin.

Pin One Orientation

ORDERING INFORMATION

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



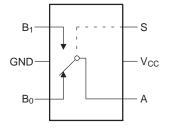


Figure 1. Logic Symbol

Figure 2. Analog Symbol

ORDERING INFORMATION

Part Number Top Mark		Operating Temperature Range	Package	Shipping [†]	
NC7SBU3157P6X	U7A	−40 to 85°C	SC70 (Pb-Free)	3000 units / Tape & Reel	
FSAU3157P6X	U7A	−40 to 85°C	SC70 (Pb-Free)	3000 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

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Units
V_{CC}	Supply Voltage		+7.0	V
Vs	DC Switch Voltage (Note 1)	-0.5	V _{CC} + 0.5	V
V _{IN}	DC Input Voltage (Note 1)	-0.5	+7.0	V
I _{IK}	DC Input Diode Current at V _{IN} < 0 V		-50	mA
l _{OUT}	DC Output Current		128	mA
I_{CC}/I_{GND}	DC V _{CC} or Ground Current		±100	mA
T _{STG}	Storage Temperature Range	-65	+150	°C
TJ	Junction Temperature Under Bias		+150	°C
TL	T _L Junction Lead Temperature (Soldering, 10 seconds)		+260	°C
P _D	Power Dissipation at +85°C		180	mW

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.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter			Max	Units
V _{CC}	Supply Voltage Operating		1.65	5.50	V
V _{IN}	Control Input Voltage (Note 2)		0	V _{CC}	V
V _{IN}	Switch Input Voltage (Note 2)		0	V _{CC}	V
V _{OUT}	Output Voltage (Note 2)		0	V _{CC}	V
T _A	Operating Temperature		-40	+85	°C
	Input Bigg and Fall Time	Control Input V _{CC} = 2.3 V – 3.6 V	0	10	ns/V
t _r , t _f	Input Rise and Fall Time	Control Input V _{CC} = 4.5 V - 5.5 V	0	5	ns/V
θ_{JA}	Thermal Resistance			350	°C/W

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.

^{1.} The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

^{2.} Control input must be held HIGH or LOW; it must not float.

DC ELECTRICAL CHARACTERISTICS

				T _A = +25°C		$T_A = -40^{\circ}$	C to +85°C	C	
Symbol	Parameter	Conditions	V _{CC} (V)	Min.	Тур.	Max.	Min.	Max.	Units
Vih	High Level Input Voltage		1.65 to 1.95	0.75 V _{CC}			0.75 V _{CC}		V
VIH	High Level Input Voltage		2.3 to 5.5	0.7 V _{CC}			0.7 V _{CC}] V
VIL	Low Level Input Voltage		1.65 to 1.95			0.25 V _{CC}		0.25 V _{CC}	V
VIL	Low Level Input Voltage		2.3 to 5.5			0.3 V _{CC}		0.3 V _{CC}	V
lin	Input Leakage Current	$0 \le V_{IN} \le 5.5V$	0 to 5.5		±0.05	±0.1		±1	μΑ
loff	Off State Leakage Current	0 ≤ A, B ≤ V _{CC}	1.65 to 5.5		±0.05	±0.1		±1	μΑ
Ron	Switch On Resistance	V _{IN} =0V, I _O =30mA	4.5		3.0	15.0		15.0	Ω
	(Note 3)	V _{IN} =2.4V, I _O =-30mA			5.0	15.0		15.0	
		V _{IN} =4.5V, I _O =-30mA			7.0	15.0		15.0	
		V _{IN} =0V, I _O =24mA	3.0		4.0	20.0		20.0	
		V _{IN} =3V, I _O =-24mA			10.0	20.0		20.0	
		V _{IN} =0V, I _O =8mA	2.3		5.0	30.0		30.0	
		V _{IN} =2.3V, I _O =-8mA			13.0	30.0		30.0	
		V _{IN} =0V, I _O =4mA	1.65		6.5	50.0		50.0	
		V _{IN} =1.65V, I _O =-4mA			17.0	50.0		50.0	
Icc	Quiescent Supply Cur- rent; All Channels On or Off	V _{IN} =V _{CC} or GND I _{OUT} =0	5.5			1		10	μΑ
	Analog Signal Range		Vcc	0		Vcc	0	Vcc	V
RRANGE	On Resistance Over Signal Range	$I_A=-30$ mA, $0 \le V_{Bn} \le V_{CC}$	4.5					25.0	Ω
	(Notes 3, 7)	$I_A=-24$ mA, $0 \le V_{Bn} \le V_{CC}$	3.0					50.0	
		$I_A=-8mA$, $0 \le V_{Bn} \le V_{CC}$	2.3					100	
		$I_A=-4mA$, $0 \le V_{Bn} \le V_{CC}$	1.65					300	
ΔR_{ON}	On Resistance Match Between– Channels	I _A =-30mA, V _{Bn} =3.15	4.5		0.15				Ω
	(Notes 3, 4, 5)	I _A =-24mA, V _{Bn} 2.1	3.0		0.2				
		I _A =-8mA, V _{Bn} =1.6	2.3		0.5				
		I _A =-4mA, V _{Bn} =1.15	1.65		0.5				
Viku	Voltage Under- shoot	$0.0\text{mA} \le I_{\text{IN}} \le -50, \overline{\text{OE}} 5.5\text{v}$	5.5					-2	V
Rflat	On Resistance Flatness	$I_A=-30mA$, $0 \le V_{Bn} \le V_{CC}$	5.0		6.0				Ω
	(Notes 3, 4, 6)	$I_A=-24mA$, $0 \le V_{Bn} \le V_{CC}$	3.3		12.0				
		$I_A=-8mA$, $0 \le V_{Bn} \le V_{CC}$	2.5		28.0				
		$I_A=-4mA$, $0 \le V_{Bn} \le V_{CC}$	1.8		125				

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 Ports).
 Parameter is characterized, but not tested in production.
 ΔR_{ON} = R_{ON} max - R_{ON} minimum measured at identical V_{CC}, temperature, and voltage levels.
 Flatness is defined as the difference between the maximum and minimum value of on resistance over the specified range of conditions.
 Guaranteed by design.

AC ELECTRICAL CHARACTERISTICS

				T,	₄ = +25°	°C	T _A = -40°0	C to +85°C		
Symbol	Parameter	Conditions	Vcc (V)	Min.	Тур.	Max.	Min.	Max.	Units	Figure
tPHL, tPLH	Propagation Delay	V _I = OPEN	1.65 to 1.95						ns	Figure 5
	Bus-to-Bus (Note 8)		2.3 to 2.7			1.2		1.2		Figure 6
			3.0 to 3.6			0.8		0.8		
			4.5 to 5.5			0.3		0.3		
tpzl, tpzh	Output Enable Time Turn-On Time	$V_1 = 2 \times V_{CC}$ for t_{PZL} $V_1 = 0 \text{ V for } t_{PZH}$	1.65 to 1.95	7.0		23.0	7.0	24.0		Figure 5
	(A to B _n)	V ₁ = 0 V IOI t _{PZH}	2.3 to 2.7	3.5		13.0	3.5	14.0		Figure 6
			3.0 to 3.6	2.5		6.9	2.5	7.6		
			4.5 to 5.5	1.7		5.2	1.7	5.7		
tPLZ, tPHZ	Output Disable Time Turn-Off Time	$V_1 = 2 \times V_{CC}$ for t_{PLZ} $V_1 = 0 \text{ V for } t_{PHZ}$	1.65 to 1.95	3.0		12.5	3.0	13.0	ns	Figure 5
	(A Port to B Port)	V ₁ = 0 V IOI t _{PHZ}	2.3 to 2.7	2.0		7.0	2.0	7.5		Figure 6
			3.0 to 3.6	1.5		5.0	1.5	5.3		
			4.5 to 5.5	0.8		3.5	0.8	3.8		
t BBM	Break-Before-Make Time (Note 9)		1.65 to 1.95	0.5			0.5		ns	Figure 7
	Time (Note 9)		2.3 to 2.7	0.5			0.5			
			3.0 to 3.6	0.5			0.5			
			4.5 to 5.5	0.5			0.5			
Q	Charge Injection	$C_L = 0.1 \text{ nF}, V_{GEN} = 0 \text{ V}$	5.0		7.0				рC	Figure 8
	(Note 9)	$R_{GEN} = 0 \Omega$	3.3		3.0					
OIRR	Off Isolation (Note 10)	$R_L = 50 \Omega$, $f = 10 MHz$	1.65 to 5.5		-57.0				dB	Figure 9
Xtalk	Crosstalk	$R_L = 50 \Omega$, $f = 10 MHz$	1.65 to 5.5		-54.0				dB	Figure 10
BW	-3dB Bandwidth	$R_L = 50 \Omega$	1.65 to 5.5		250				MHz	Figure 13
THD	Total Harmonic Distortion (Note 9)	$R_L = 600 \Omega$, 0.5 V_{PP} , $f = 20 \text{ Hz to } 20 \text{ KHz}$	5.0		.011				%	

^{8.} This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the on resistance of the switch and the 50pF load capacitance, when driven by an ideal voltage source (zero output impedance).

CAPACITANCE (Note 11)

Symbol	Parameter	Conditions	Тур.	Max.	Units	Figure
CIN	Control Pin Input Capacitance	$V_{CC} = 0 V$	2.3		pF	
Сю-в	B Port Off Capacitance	V _{CC} = 5.0 V	6.5		pF	Figure 11
CIOA-ON	A Port Capacitance When Switch Is Enabled	V _{CC} = 5.0 V	18.5		pF	Figure 12

^{11.} T_A = +25°C, f = 1 MHz, Capacitance is characterized, but not tested in production.

UNDERSHOOT CHARACTERISTIC (Note 12)

Symbol	Parameter	Min.	Тур.	Units	Figure
Vоити	Output Voltage During Undershoot	2.5	V _{OH} – 0.3	V	Figure 3

^{12.} This test is intended to characterize the device's protective capabilities by maintaining output signal integrity during an input transient voltage undershoot event.

^{9.} Guaranteed by design.

^{10.} Off Isolation = $20 \log_{10} [V_A / V_{Bn}]$.

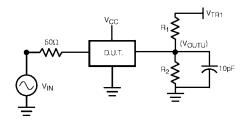


Figure 3. Output Voltage During Undershoot

DEVICE TEST CONDITIONS

Parameter	Value	Units
V _{IN}	see Figure 4	V
$R_1 = R_2$	100	ΚΩ
V _{TRI}	7.0	V
V _{CC}	5.5	V

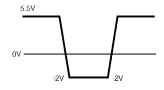
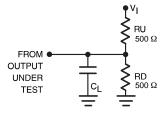


Figure 4. Transient Input Voltage Waveform

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 5. AC Test Circuit

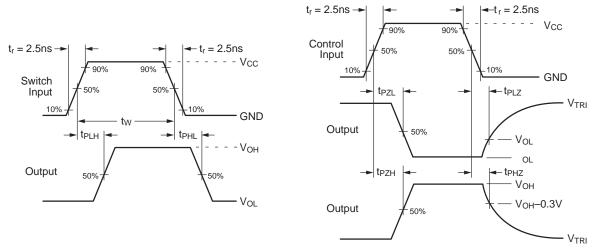


Figure 6. AC Waveforms

AC Loading and Waveforms (continued)

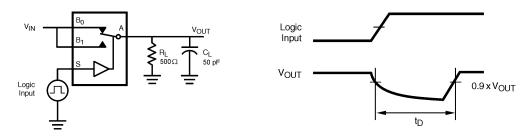


Figure 7. Break-Before-Make Interval Timing

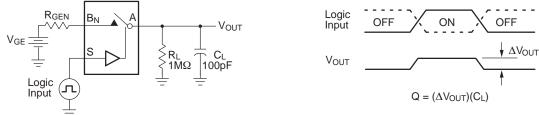


Figure 8. Charge Injection Test

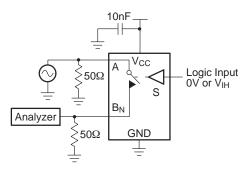


Figure 9. Off Isolation

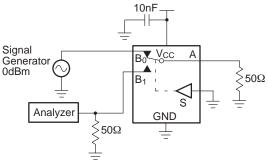


Figure 10. Crosstalk

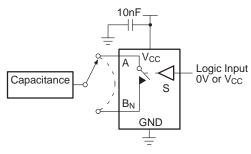


Figure 11. Channel Off Capacitance

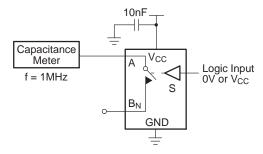


Figure 12. Channel On Capacitance

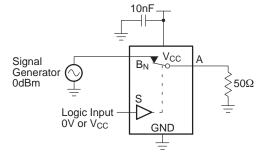
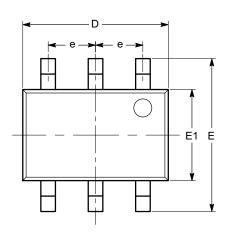


Figure 13. Bandwidth

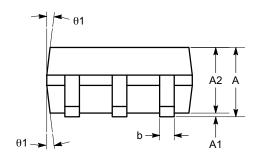


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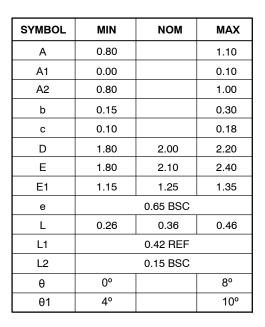
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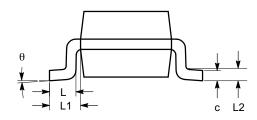


TOP VIEW



SIDE VIEW





END VIEW

Notes:

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-203.

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