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

NC7SBU3157, FSAU3157

ON Semiconductor®

www.onsemi.com

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

General Description

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

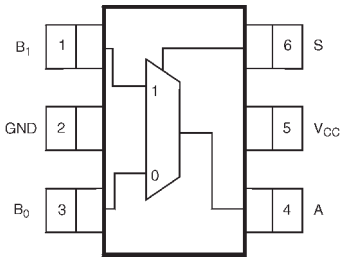
The device is fabricated with advanced sub−micron CMOS technology to achieve high−speed enable and disable times and low on resistance. The break−beforemake select circuitry prevents disruption of signals on the B port due to both switches temporarily being enabled during select pin switching. The device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

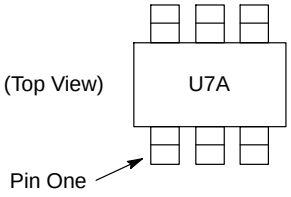
- Analog and Digital Applications
- Space−saving, SC70 6−lead, Surface−mount Package
- Low On Resistance: <10 Ω on typical at 3.3 V V_{CC}
- Broad V_{CC} Operating Range: 1.65 V to 5.5 V
- Rail−to−rail Signal Handling
- Power−down, High−impedance Control Input
- Over−voltage Tolerance of Control Input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

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

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

ORDERING INFORMATION

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

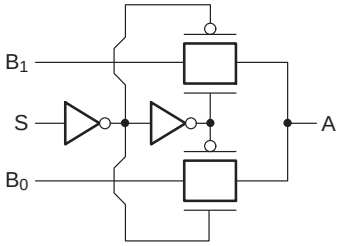


Figure 1. Logic Symbol

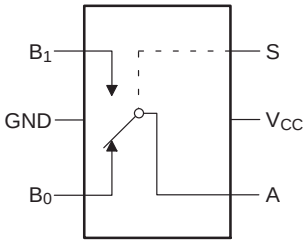


Figure 2. Analog Symbol

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	–0.5	+7.0	V
V_S	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
I_{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
T_J	Junction Temperature Under Bias		+150	°C
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.

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

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	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
t_r, t_f	Input Rise and Fall Time	Control Input V_{CC} = 2.3 V – 3.6 V	0	10	ns/V
		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.

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

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = +25°C			T_A = –40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage		1.65 to 1.95	0.75 V_{CC}			0.75 V_{CC}		V
			2.3 to 5.5	0.7 V_{CC}			0.7 V_{CC}		
V_{IL}	Low Level Input Voltage		1.65 to 1.95			0.25 V_{CC}		0.25 V_{CC}	V
			2.3 to 5.5			0.3 V_{CC}		0.3 V_{CC}	
I_{IN}	Input Leakage Current	$0 \le V_{IN} \le 5.5V$	0 to 5.5		±0.05	±0.1		±1	μA
I_{OFF}	Off State Leakage Current	$0 \le A, B \le V_{CC}$	1.65 to 5.5		±0.05	±0.1		±1	μA
R_{ON}	Switch On Resistance (Note 3)	V_{IN}=0V, I_O=30mA	4.5		3.0	15.0		15.0	Ω
		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	
I_{CC}	Quiescent Supply Current; All Channels On or Off	V_{IN}=V_{CC} or GND I_{OUT}=0	5.5			1		10	μA
	Analog Signal Range		Vcc	0		Vcc	0	Vcc	V
R_{RANGE}	On Resistance Over Signal Range (Notes 3, 7)	I_A=–30mA, $0 \le V_{Bn} \le V_{CC}$	4.5					25.0	Ω
		I_A=–24mA, $0 \le V_{Bn} \le V_{CC}$	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 (Notes 3, 4, 5)	I_A=–30mA, V_{Bn}=3.15	4.5		0.15				Ω
		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				
V_{IKU}	Voltage Under− shoot	0.0mA ≤ I_{IN} ≤–50, $\overline{OE}$ 5.5v	5.5					−2	V
R_{flat}	On Resistance Flatness (Notes 3, 4, 6)	I_A=–30mA, $0 \le V_{Bn} \le V_{CC}$	5.0		6.0				Ω
		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				

3. 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).
4. Parameter is characterized, but not tested in production.
5. $\Delta R_{ON} = R_{ON}$ max – R_{ON} minimum measured at identical V_{CC}, temperature, and voltage levels.
6. Flatness is defined as the difference between the maximum and minimum value of on resistance over the specified range of conditions.
7. Guaranteed by design.

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	VCC (V)	T_A = +25°C			T_A = –40°C to +85°C		Units	Figure
				Min.	Typ.	Max.	Min.	Max.		
t_{PHL}, t_{PLH}	Propagation Delay Bus−to−Bus (Note 8)	V_I = OPEN	1.65 to 1.95						ns	Figure 5 Figure 6
			2.3 to 2.7			1.2		1.2		
			3.0 to 3.6			0.8		0.8		
			4.5 to 5.5			0.3		0.3		
t_{PZL}, t_{PZH}	Output Enable Time Turn−On Time (A to B_n)	V_I = 2 x V_{CC} for t_{PZL} V_I = 0 V for t_{PZH}	1.65 to 1.95	7.0		23.0	7.0	24.0	ns	Figure 5 Figure 6
			2.3 to 2.7	3.5		13.0	3.5	14.0		
			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		
t_{PLZ}, t_{PHZ}	Output Disable Time Turn−Off Time (A Port to B Port)	V_I = 2 x V_{CC} for t_{PLZ} V_I = 0 V for t_{PHZ}	1.65 to 1.95	3.0		12.5	3.0	13.0	ns	Figure 5 Figure 6
			2.3 to 2.7	2.0		7.0	2.0	7.5		
			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
			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 (Note 9)	C_L = 0.1 nF, V_{GEN} = 0 V	5.0		7.0				pC	Figure 8
		R_{GEN} = 0 Ω	3.3		3.0					
OIRR	Off Isolation (Note 10)	R_L = 50 Ω, f = 10 MHz	1.65 to 5.5		–57.0				dB	Figure 9
Xtalk	Crosstalk	R_L = 50 Ω, f = 10 MHz	1.65 to 5.5		–54.0				dB	Figure 10
BW	–3dB Bandwidth	R_L = 50 Ω	1.65 to 5.5		250				MHz	Figure 13
THD	Total Harmonic Distortion (Note 9)	R_L = 600 Ω, 0.5 V_{PP}, f = 20 Hz to 20 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).
9. Guaranteed by design.
10. Off Isolation = 20 $\log_{10}$ [V_A / V_{Bn}].

CAPACITANCE (Note 11)

Symbol	Parameter	Conditions	Typ.	Max.	Units	Figure
C_{IN}	Control Pin Input Capacitance	V_{CC} = 0 V	2.3		pF	
C_{IO-B}	B Port Off Capacitance	V_{CC} = 5.0 V	6.5		pF	Figure 11
C_{IOA-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.	Typ.	Units	Figure
V_{OUTU}	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.

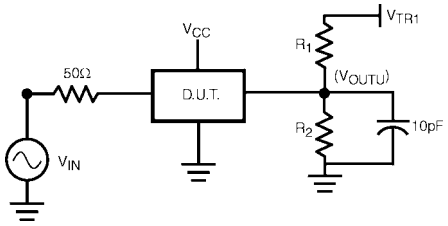


Figure 3. Output Voltage During Undershoot

DEVICE TEST CONDITIONS

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

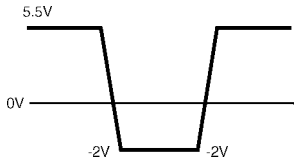
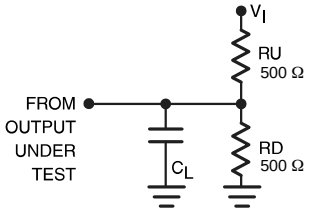


Figure 4. Transient Input Voltage Waveform

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

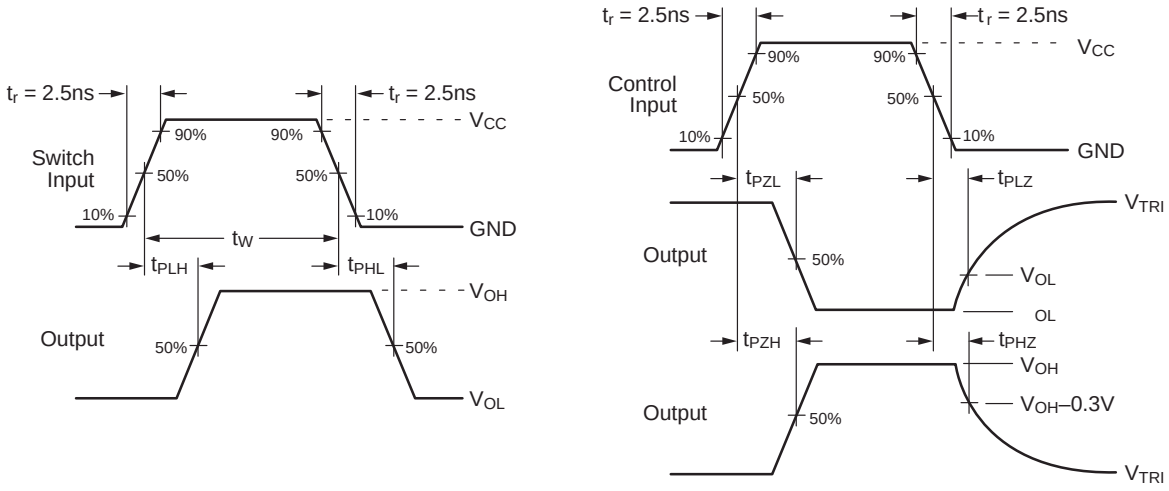


Figure 6. AC Waveforms

AC Loading and Waveforms (continued)

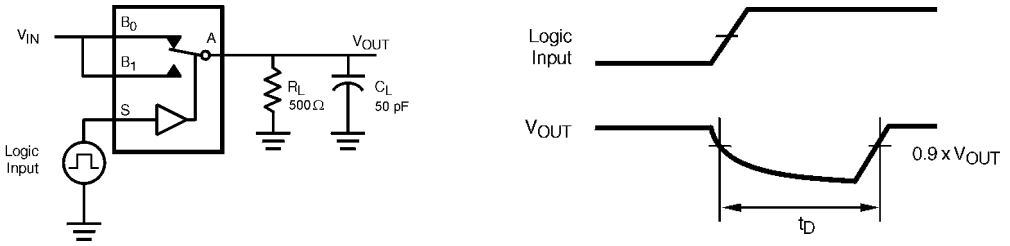


Figure 7. Break−Before−Make Interval Timing

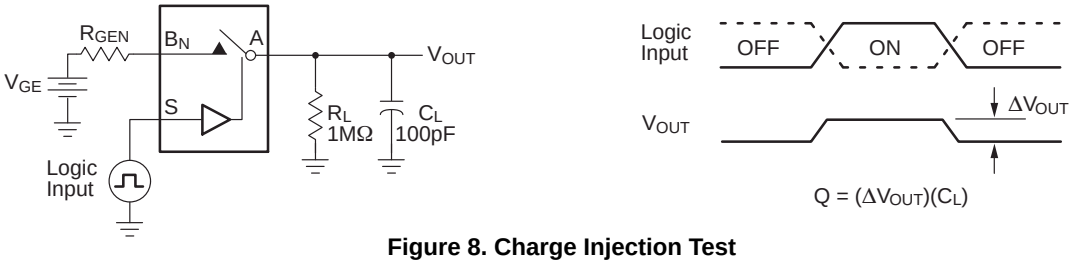


Figure 8. Charge Injection Test

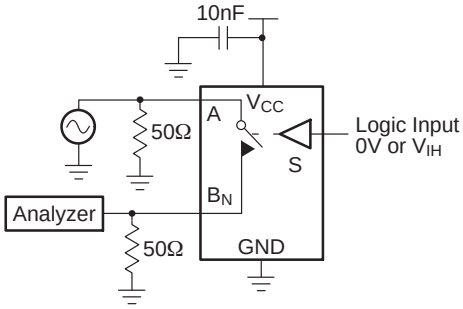


Figure 9. Off Isolation

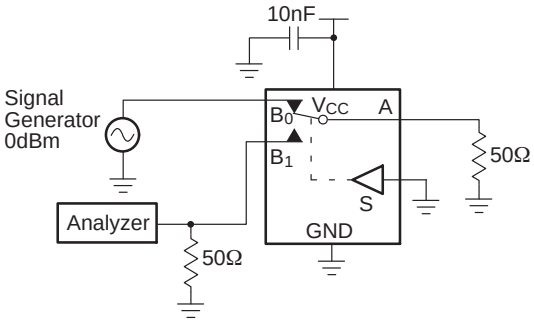


Figure 10. Crosstalk

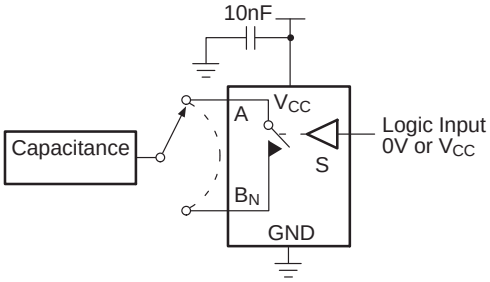


Figure 11. Channel Off Capacitance

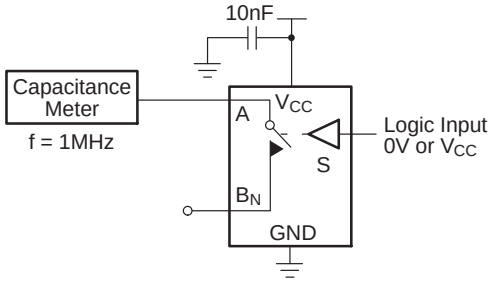


Figure 12. Channel On Capacitance

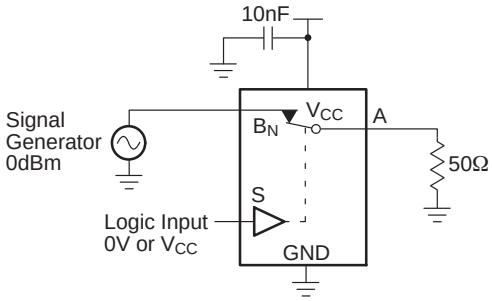
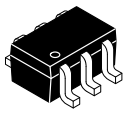


Figure 13. Bandwidth

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS



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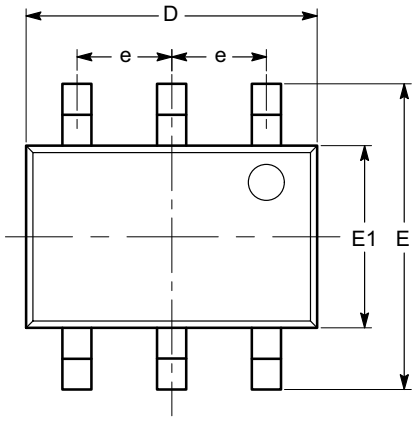
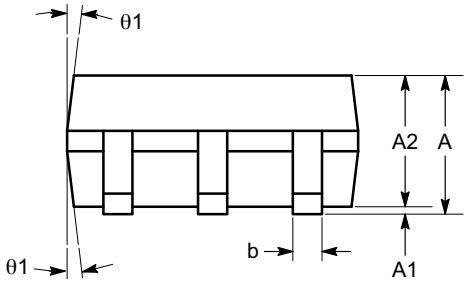
ISSUE A

DATE 07 JUL 2010

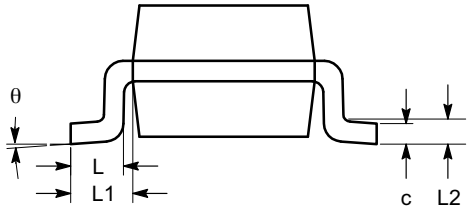


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	0.80		1.10
A1	0.00		0.10
A2	0.80		1.00
b	0.15		0.30
c	0.10		0.18
D	1.80	2.00	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e		0.65 BSC	
L	0.26	0.36	0.46
L1		0.42 REF	
L2		0.15 BSC	
θ	0°		8°
θ1	4°		10°



SIDE VIEW



END VIEW

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

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