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FSA3051 — High Performance SPDT Analog Switch with Over-Voltage Tolerance

Features

- Low On Capacitance: 7.7 pF Typical
- Low On Resistance: 6 Ω Typical
- Low Power Consumption: 1 μA Maximum
 - 15 μA Maximum I_{CC}T over an Expanded Voltage Range (V_{IN}=1.8 V, V_{CC}=5.5 V)
- Wide -3 db Bandwidth: 1.0 GHz
- Packaged in Ultra Small 6-Lead TMLP
- Broad V_{CC} Operating Range: 1.6 V to 5.5 V
- Over-Voltage Tolerance (OVT) on all Data Ports up to 6 V without External Components

Applications

- Cell Phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box

Description

The FSA3051 is a 6 Ω, bi-directional, low-power, two-port, high-speed, Single Pole / Double Throw (SPDT) analog switch. It features an extremely low on capacitance (C_{ON}) of 7.7 pF and wide bandwidth of 1.0 GHz.

The FSA3051 contains special circuitry on the switch I/O pins for applications where the V_{CC} supply is powered-off (V_{CC}=0 V), which allows the device to withstand an over-voltage condition. This device is designed to minimize current consumption even when the control voltage applied to the select (S) pin is lower than the supply voltage (V_{CC}). This feature is especially valuable to ultra-portable applications, such as cell phones, allowing for direct interface with the general-purpose I/Os of the baseband processor. Other applications include switching in portable cell phones, PDAs, digital cameras, printers, and notebook computers.

Ordering Information

Part Number	Top Mark	Operating Temperature Range	Package
FSA3051TMX	NT	-40 to +85°C	6-Lead, Dual, Ultra-ultrathin Molded Leadless Package (TMLP), 1.0 x 1.0 mm. Top left unit orientation in carrier tape.
FSA3051TMX_F147	NT	-40 to +85°C	6-Lead, Dual, Ultra-ultrathin Molded Leadless Package (TMLP), 1.0 x 1.0 mm. Bottom left unit orientation in carrier tape.

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Analog Symbols

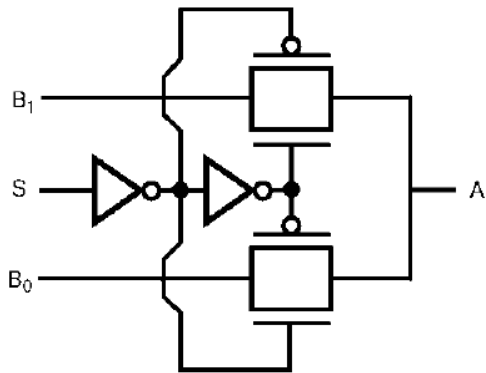


Figure 1. Logic Symbol

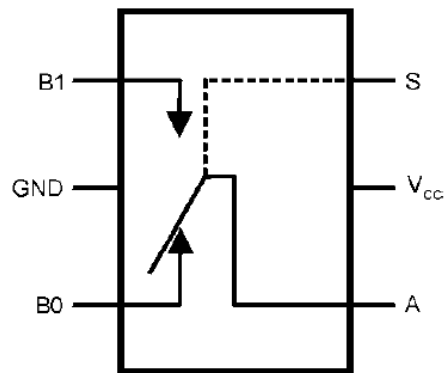


Figure 2. Analog Symbol

Pin Assignments

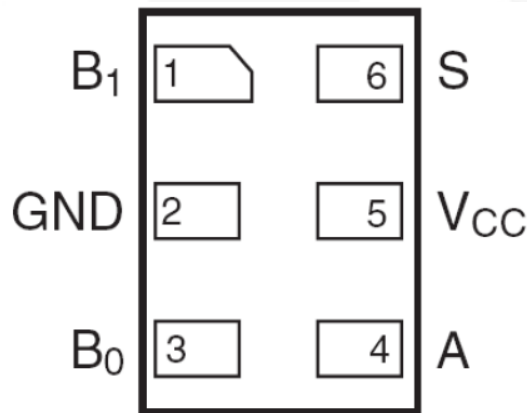


Figure 3. 6-Lead TMLP (Top-Through View)

Pin Definitions

UMLP Pin#	Name	Description
1	B ₁	Data Port
2	GND	Ground
3	B ₀	Data Port
4	A	Data Port
5	V _{CC}	Supply Voltage
6	S	Switch Select

Truth Table

S	Function
LOW	B ₀ connected to A
HIGH	B ₁ connected to A

Notes:

1. LOW $\leq V_{IL}$.
2. HIGH $\geq V_{IH}$.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Min.	Max.	Unit
V _{CC}	Supply Voltage	-0.5	6.0	V
V _{CNTRL}	DC Input Voltage ⁽³⁾	-0.5	V _{CC}	V
V _{SW}	DC Switch I/O Voltage ⁽³⁾	-0.50	6.00	V
I _{IK}	DC Input Diode Current	-50		mA
I _{OUT}	DC Output Current		50	mA
T _{STG}	Storage Temperature	-65	+150	°C
MSL	Moisture Sensitivity Level (JEDEC J-STD-020A)		1	Level
ESD	Human Body Model, ANSI/ESDA/JEDEC JS-001-2012	All Pins	2	kV
		I/O to GND	2	
		Power to GND	2	
	Charged Device Model, JEDEC: JESD22-C101	1		

Note:

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

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit
V _{CC}	Supply Voltage	1.6	5.5	V
V _{CNTRL}	Control Input Voltage (S) ⁽⁴⁾	0	V _{CC}	V
V _{SW}	Switch I/O Voltage	-0.5	5.5	V
T _A	Operating Temperature	-40	+85	°C

Note:

4. The control input must be held HIGH or LOW and it must not float.

DC Electrical Characteristics

All typical value are at $T_A=25^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter	Condition	V_{CC} (V)	$T_A=-40^\circ\text{C}$ to $+85^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
V_{IK}	Clamp Diode Voltage	$I_{IN}=-18\text{ mA}$	3.0			-1.2	V
V_{IH}	Input Voltage High		1.8 to 4.3	1.3			V
			4.3 to 5.5	1.7			
V_{IL}	Input Voltage Low		1.8 to 4.3			0.5	V
			4.3 to 5.5			0.7	
I_{IN}	Control Input Leakage	$V_{CNTRL}=0$ to V_{CC}	1.8	-1		1	μA
			5.5	-1		1	
I_{OZ}	Off State Leakage	$V_{SW}=0\text{ V}$ to V_{CC}	1.8	-2		2	μA
		$V_{SW}=0\text{ V}$ to 3.6 V	5.5	-2		2	
I_{OFF}	Power-Off Leakage Current (All I/O Ports)	$V_{SW}=0\text{ V}$ to 4.3 V, $V_{CC}=0\text{ V}$ Figure 5	0	-2		2	μA
R_{ON}	Switch On Resistance ⁽⁵⁾	$V_{SW}=0.4\text{ V}$, $I_{ON}=-8\text{ mA}$ Figure 4	3.0		4	10	Ω
		$V_{SW}=1.8\text{ V}$, $I_{ON}=-8\text{ mA}$ Figure 4	3.0		6	10	
R_{ON}	Switch On Resistance ⁽⁵⁾	$V_{SW}=0.4\text{ V}$, $I_{ON}=-8\text{ mA}$ Figure 4	1.8		6	10	Ω
		$V_{SW}=1.8\text{ V}$, $I_{ON}=-8\text{ mA}$ Figure 4	1.8		14	25	
ΔR_{ON}	On Resistance Match Between Channels ^(5,6)	$V_{SW}=0.4\text{ V}$, $I_{ON}=-8\text{ mA}$	3.0		35		$\text{m}\Omega$
			1.8		40		
I_{CC}	Quiescent Supply Current	$V_{CNTRL}=0$ or V_{CC} , $I_{OUT}=0$	5.5			1	μA
I_{CCT}	Increase in I_{CC} Current per Control Voltage and V_{CC}	$V_{CNTRL}=1.8\text{ V}$	3.0			10	μA
		$V_{CNTRL}=2.6\text{ V}$	5.5			10	
		$V_{CNTRL}=1.8\text{ V}$	5.5			15	

Notes:

5. Measured by the voltage drop between A and Bn pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (A or Bn ports).
6. $\Delta R_{ON} = R_{ON}$ maximum - R_{ON} minimum measured at identical V_{CC} , temperature, and voltage levels.
7. Guaranteed by characterization.

AC Electrical Characteristics⁽⁸⁾

All typical value are for $V_{CC}=3.3$ V at $T_A=25^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter	Condition	V_{CC} (V)	$T_A=-40^\circ\text{C}$ to $+85^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
t_{ON}	Turn-On Time S to Output	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW}=0.8\ \text{V}$, Figure 6, Figure 7	3.0 to 3.6		34		ns
			1.8		110		
t_{OFF}	Turn-Off Time S to Output	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW}=0.8\ \text{V}$, Figure 6, Figure 7	3.0 to 3.6		23		ns
			1.8		50		
t_{PD}	Propagation Delay	$C_L=5\ \text{pF}$, $R_L=50\ \Omega$, Figure 6, Figure 8	3.3		0.2		ns
			1.8		0.3		
t_{BBM}	Break-Before-Make	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW1}=V_{SW2}=0.8\ \text{V}$, Figure 9	3.0 to 3.6	15		50	ns
			1.8			100	
O_{IRR}	Off Isolation	$R_L=50\ \Omega$, $f=240\ \text{MHz}$, Figure 11	1.8		-20		dB
			3.0 to 3.6		-23		
Xtalk	Crosstalk	$R_L=50\ \Omega$, $f=240\ \text{MHz}$, Figure 12	1.8		-18		dB
			3.0 to 3.6		-23		
BW	-3 db Bandwidth	$R_L=50\ \Omega$, $C_L=0\ \text{pF}$, $V_{SW}=0.4\ \text{V}$	1.8		810		MHz
		$R_L=50\ \Omega$, $C_L=0\ \text{pF}$, Figure 10	3.0 to 3.6		1		GHz
		$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, Figure 10			750		MHz

Note:

8. Guaranteed by characterization. Not production tested.

Capacitance⁽⁹⁾

Symbol	Parameter	Condition	V_{CC} (V)	$T_A=-40^\circ\text{C}$ to $+85^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance		0		1.5		pF
C_{ON}	A Port On Capacitance	$f=1\ \text{MHz}$,	3.0		7.7		
		$f=240\ \text{MHz}$, Figure 14	3.3		7.7		
		$f=1\ \text{MHz}$,	1.8		10.0		
		$f=240\ \text{MHz}$, Figure 14	1.8		5.0		
C_{OFF}	Bn Port Off Capacitance	$f=1\ \text{MHz}$	3.0		3.3		
		$f=240\ \text{MHz}$, Figure 13	3.3		3.3		
		$f=1\ \text{MHz}$	1.8		5.0		
		$f=240\ \text{MHz}$, Figure 13	1.8		4.0		

Note:

9. Not production tested.

Test Diagrams

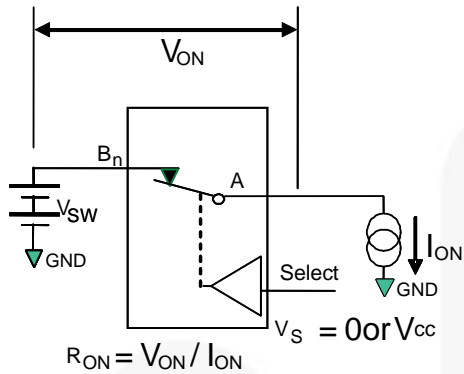
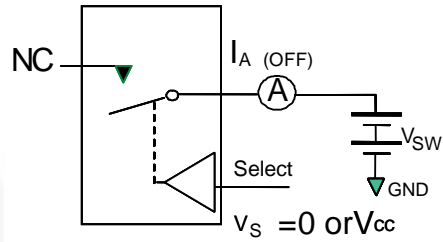
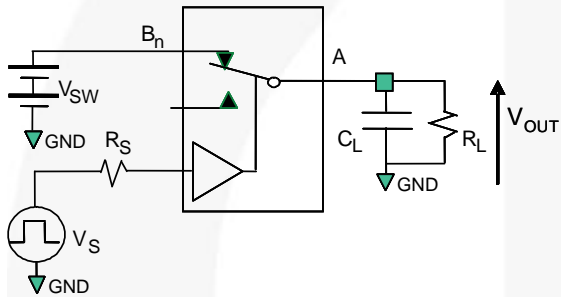


Figure 4. On Resistance



**Each switch port is tested separately

Figure 5. Off Leakage



R_L , R_S , and C_L are functions of the application environment (see AC Tables for specific values)
 C_L includes test fixture and stray capacitance.

Figure 6. AC Test Circuit Load

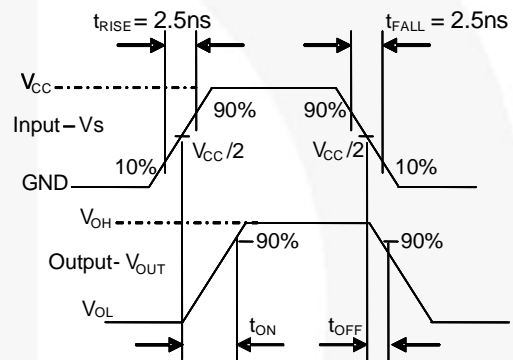


Figure 7. Turn-On / Turn-Off Waveforms

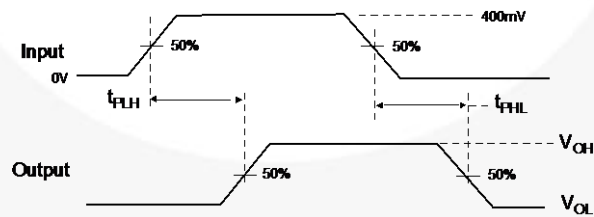


Figure 8. Propagation Delay ($t_{rTF} = 500$ ps)

Test Diagrams (Continued)

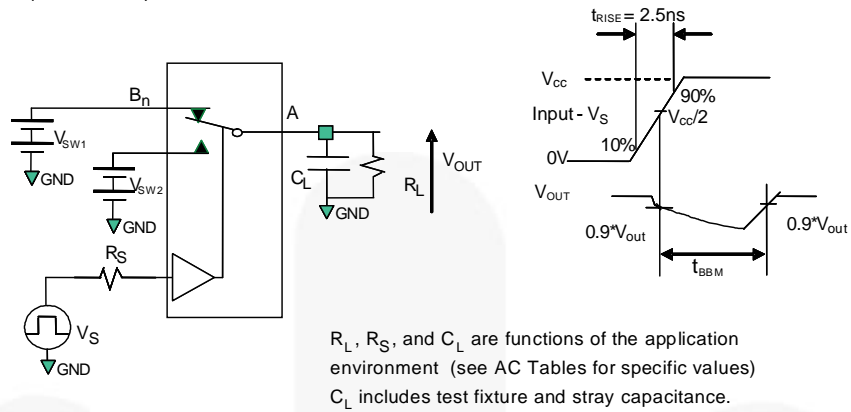


Figure 9. Break-Before-Make Interval Timing

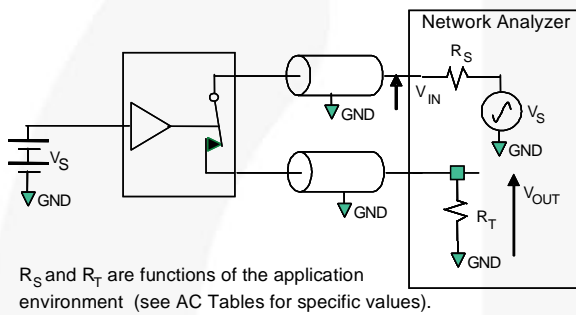


Figure 10. Bandwidth

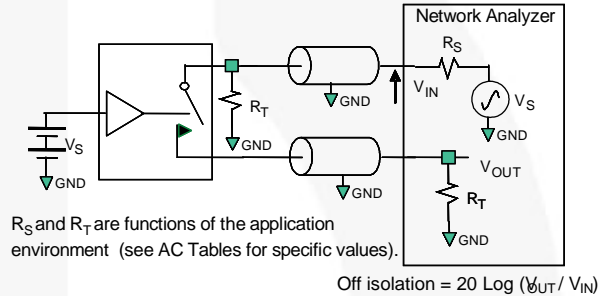


Figure 11. Channel Off Isolation

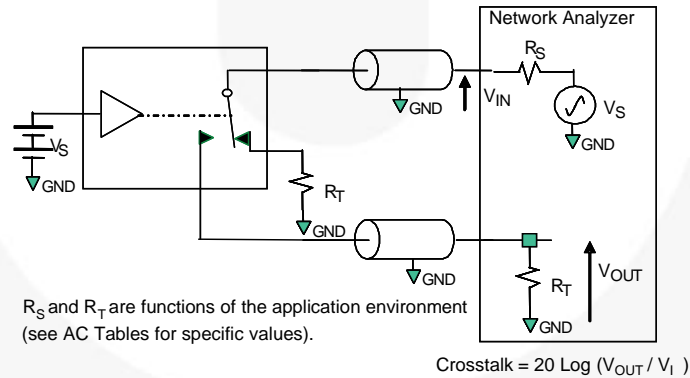


Figure 12. Channel-to-Channel Crosstalk

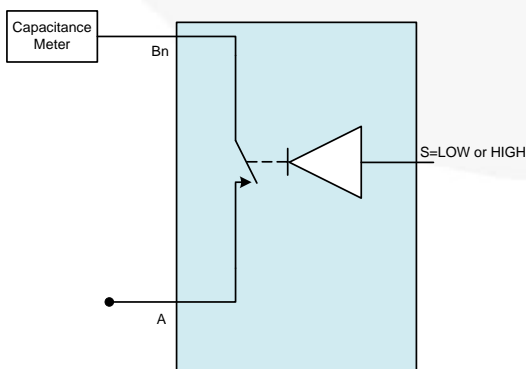


Figure 13. Channel Off Capacitance

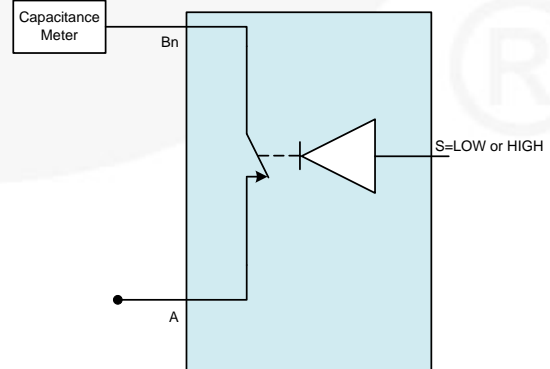
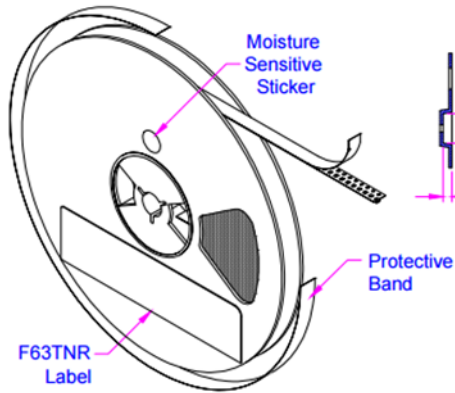


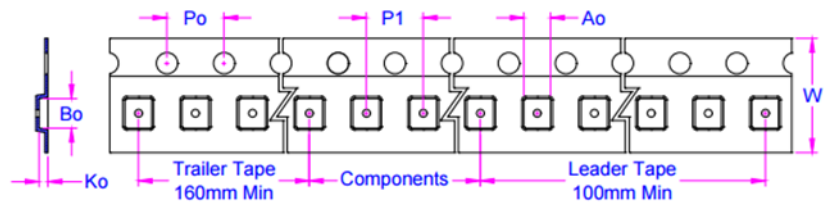
Figure 14. Channel On Capacitance

Carrier Tape Orientation

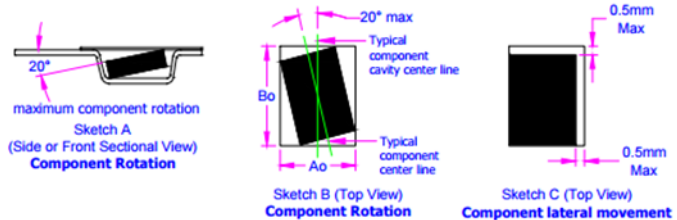
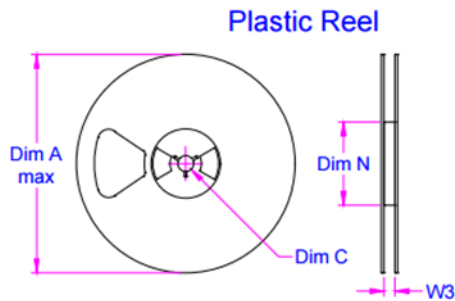
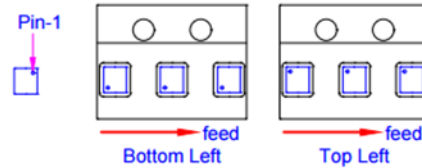
TMLP TNR CONFIGURATION



Embossed Carrier Tape



Unit Orientation - refer to below table per MOD orientation



Notes:

Ao, Bo, and Ko dimensions are determined with respect to the EIA-481 rotational and lateral movement requirements (see sketches A, B, & C). Camber requirement also compliant to above mentioned standards.

Figure 15. TMLP Carrier Tape Packing

Part Number	Unit Orientation
FSA3051TMX	Top Left
FSA3051TMX_F147	Bottom Left



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