FAIRCHILD SEMICONDUCTOR™

April 2004
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FSUSB11
Low Power High Bandwidth USB Switch Dual SPDT Multiplexer/Demultiplexer

General Description

The FSUSB11 is a high performance Dual Single Pole Double Throw (SPDT) analog switch specially designed for the switching of both analog audio signal and USB 1.1 signals. The device features ultra low R_{ON} of 1.3Ω maximum at 4.5V V_{CC} and 4.3Ω at 2.7V supply. High bandwidth and ultra low ON Resistance (R_{ON}) make this switch to be able to pass both USB low and full speed signal with minimum signal distortion. The device is fabricated with sub-micron CMOS technology to achieve fast switching speeds and is designed for break-before-make operation. The select input is TTL level compatible.

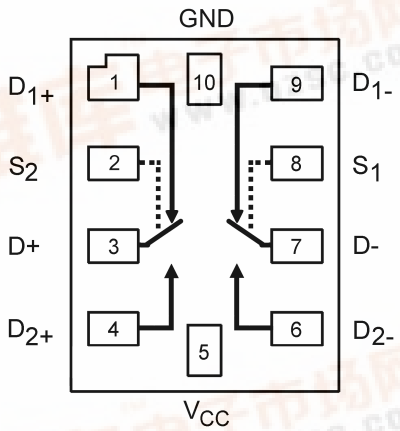
Features

- Space saving MicroPak™ packaging (1.6mm x 2.1mm)
- USB 1.1 signal switching compliant
- –3db bandwidth: >350MHz
- Maximum 1.15Ω ON Resistance at 4.5V V_{CC} and 4Ω for 2.7V supply
- 0.3Ω maximum R_{ON} flatness for +5V supply
- Broad V_{CC} operating range: 1.65V to 5.5V
- Fast turn-on and turn-off time
- Break-before-make enable circuitry
- Over-voltage tolerant TTL compatible control input

Ordering Code:

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
FSUSB11L10X	MAC010A	ET	10-Lead MicroPak, 1.6 mm x 2.1mm	5K Units on Tape and Reel

Analog Symbols



(Top Through View)

Truth Table

Control Input(s)	Function
L	D_1 Connected to D+/D–
H	D_2 Connected to D+/D–

H = HIGH Logic Level
L = LOW Logic Level

Pin Descriptions

Pin Names	Function
D, D_1, D_2	Data Ports
S	Control Input

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

Absolute Maximum Ratings(Note 1)

Supply Voltage (V_{CC})	−0.5V to +6.0V
Switch Voltage (V_S) (Note 2)	−0.5V to V_{CC} + 0.5V
Input Voltage (V_{IN}) (Note 2)	−0.5V to +6.0V
Input Diode Current	−50 mA
Switch Current	200 mA
Peak Switch Current (Pulsed at 1 ms duration, <10% Duty Cycle)	400 mA
Storage Temperature Range (T_{STG})	−65°C to +150°C
Maximum Junction Temperature (T_J)	+150°C
Lead Temperature (T_L) Soldering, 10 seconds	+260°C
ESD Human Body Model	8000V

Recommended Operating Conditions

Supply Voltage (V_{CC})	1.65V to 5.5V
Control Input Voltage (V_{IN}) (Note 3)	0V to V_{CC}
Switch Input Voltage (V_{IN})	0V to V_{CC}
Operating Temperature (T_A)	−40°C to +85°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 2: The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

Note 3: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics (All typical values are @ 25°C unless otherwise specified)

Symbol	Parameter	V_{CC} (V)	T_A = +25°C			T_A = −40°C to +85°C		Units	Conditions
			Min	Typ	Max	Min	Max		
V_{IH}	Input Voltage High	2.7 to 3.6				2.0		V	
		4.5 to 5.5				2.4			
V_{IL}	Input Voltage Low	2.7 to 3.6					0.6	V	
		4.5 to 5.5					0.8		
I_{IN}	Control Input Leakage	2.7 to 3.6				−1.0	1.0	µA	V_{IN} = 0V to V_{CC}
		4.5 to 5.5				−1.0	1.0		
$I_{NO(OFF)}$, $I_{NC(OFF)}$	OFF-Leakage Current of Port D_1 and D_2	5.5	-50.0		50.0	−100	100	nA	A = 1V, 4.5V B_0 or B_1 = 1V, 4.5V
$I_{A(ON)}$	ON Leakage Current of Port D	5.5	−50.0		50.0	−100	100	nA	A = 1V, 4.5V B_0 or B_1 = 1V, 4.5V or Floating
R_{ON}	Switch ON Resistance (Note 4)	2.7		2.6	4.0		4.3	Ω	I_{OUT} = 100 mA, D_1 or D_2 = 1.5V
		4.5		0.95	1.15		1.3		I_{OUT} = 100 mA, D_1 or D_2 = 3.5V
ΔR_{ON}	ON Resistance Matching Between Channels (Note 5)	2.7						Ω	I_{OUT} = 100 mA, D_1 or D_2 = 1.5V
		4.5		0.06	0.12		0.15		I_{OUT} = 100 mA, D_1 or D_2 = 3.5V
$R_{FLAT(ON)}$	ON Resistance Flatness (Note 6)	2.7		1.4				Ω	I_{OUT} = 100 mA, D_1 or D_2 = 0V, 0.75V, 1.5V
		4.5		0.2	0.3		0.4		I_{OUT} = 100 mA, B_0 or B_1 = 0V, 1V, 2V
I_{CC}	Quiescent Supply Current	3.6		0.1	0.5		1.0	µA	V_{IN} = 0V or V_{CC}, I_{OUT} = 0V
		5.5		0.1	0.5		1.0		

Note 4: ON Resistance is determined by the voltage drop between D and D_n pins at the indicated current through the switch.

Note 5: $\Delta R_{ON} = R_{ONmax} - R_{ONmin}$ measured at identical V_{CC}, temperature, and voltage.

Note 6: Flatness is defined as the difference between the maximum and minimum value of ON Resistance over the specified range of conditions.

AC Electrical Characteristics (All typical value are @ 25°C unless otherwise specified)

Symbol	Parameter	V_{CC} (V)	$T_A = +25°C$			$T_A = -40°C$ to $+85°C$		Units	Conditions	Figure Number
			Min	Typ	Max	Min	Max			
t_{ON}	Turn ON Time	2.7 to 3.6			50.0		60.0	ns	D_1 or D_2 = 1.5V, R_L = 50Ω, C_L = 35 pF	Figure 1
		4.5 to 5.5			35.0		40.0		D_1 or D_2 = 3.0V, R_L = 50Ω, C_L = 35 pF	
t_{OFF}	Turn OFF Time	2.7 to 3.6			20.0		30.0	ns	D_1 or D_2 = 1.5V, R_L = 50Ω, C_L = 35 pF	Figure 1
		4.5 to 5.5			15.0		20.0		D_1 or D_2 = 3.0V, R_L = 50Ω, C_L = 35 pF	
t_{B-M}	Break-Before-Make Time	2.7 to 3.6				1.0		ns	D_1 or D_2 = 1.5V, R_L = 50Ω, C_L = 35 pF	Figure 2
		4.5 to 5.5		20.0		1.0			D_1 or D_2 = 3.0V, R_L = 50Ω, C_L = 35 pF	
Q	Charge Injection	2.7 to 3.6		20.0				pC	C_L = 1.0 nF, V_{GEN} = 0V, R_{GEN} = 0Ω	Figure 4
		4.5 to 5.5		10.0						
OIRR	OFF-Isolation	2.7 to 3.6		−70.0				dB	f = 1MHz, R_L = 50Ω	Figure 3
		4.5 to 5.5		−70.0						
Xtalk	Crosstalk	2.7 to 3.6		−75.0				dB	f = 1MHz, R_L = 50Ω	Figure 3
		4.5 to 5.5		−75.0						
BW	−3db Bandwidth	2.7 to 3.6		350				MHz	R_L = 50Ω	Figure 6
		4.5 to 5.5		350						

USB Related AC Electrical Characteristics

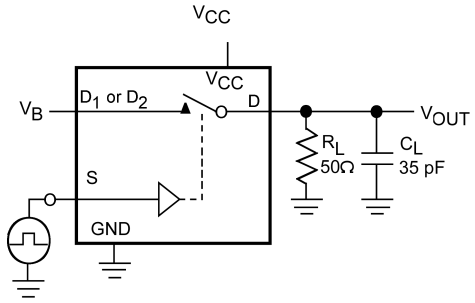
(All typical value are @25°C unless otherwise specified)

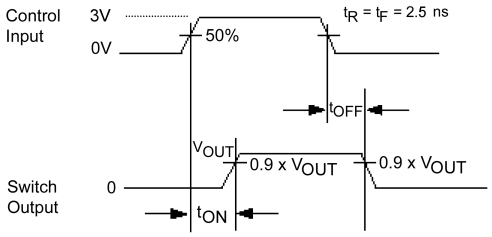
Symbol	Parameter	V_{CC} (V)	$T_A = +25°C$			Units	Conditions	Figure Number
			Min	Typ	Min			
t_{SKEW}	Skew	2.7 to 3.6		0.15		ns	R_S = 39Ω, C_L = 50 pF $t_R = t_F$ = 12ns at 12Mbps (Duty Cycle = 50%)	Figure 7
		4.5 to 5.5		0.15				
t_M	Rising/Fall Time Mismatch	2.7 to 3.6			10.0	%		Figure 7
		4.5 to 5.5			10.0			
t_J	Total Jitter	2.7 to 3.6		1.7		ns	R_S = 39Ω, C^L = 50 pF, $t_R = t_F$ = 12 ns at 12Mbps (PRBS = $2^{15} - 1$)	Figure 7
		4.5 to 5.5		1.6				

Capacitance

Symbol	Parameter	V_{CC} (V)	$T_A = +25°C$			Units	Conditions
			Min	Typ	Max		
C_{IN}	Control Pin Input Capacitance	0.0		3.5		pF	f = 1MHz (see Figure 5)
C_{OFF}	D_n Port OFF Capacitance	4.5		12.0		pF	f = 1MHz (see Figure 5)
C_{ON}	D Port ON Capacitance	4.5		55.0		pF	f = 1MHz (see Figure 5)

AC Loading and Waveforms

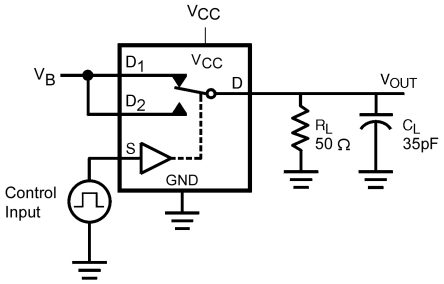


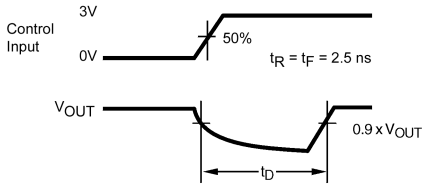


C_L includes Fixture and Stray Capacitance

Logic Input Waveforms Inverted for Switches that have the Opposite Logic Sense

FIGURE 1. Turn-On/Turn-Off Timing





C_L Includes Fixture and Stray Capacitance

FIGURE 2. Break-Before-Make Timing

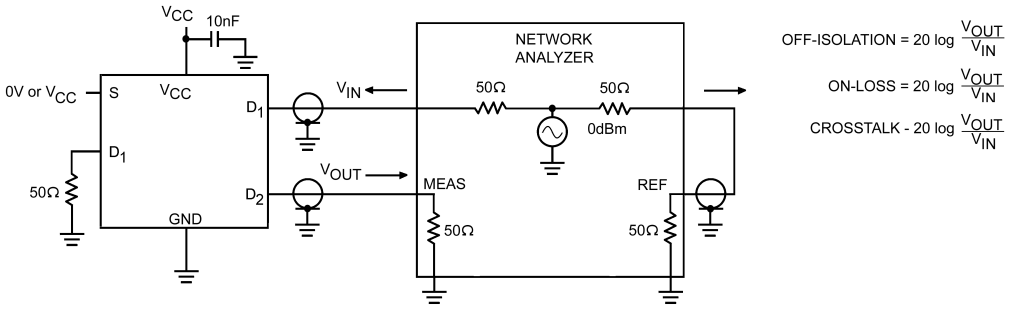


FIGURE 3. OFF Isolation and Crosstalk

AC Loading and Waveforms (Continued)

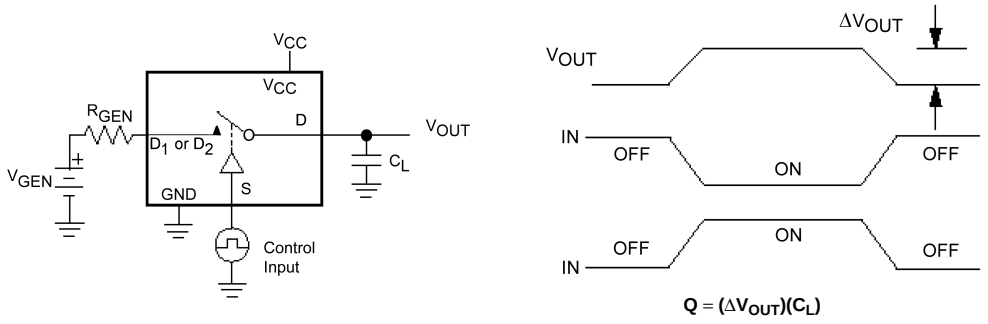


FIGURE 4. Charge Injection

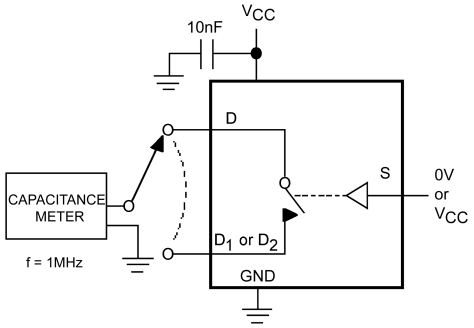


FIGURE 5. ON/OFF Capacitance Measurement Setup

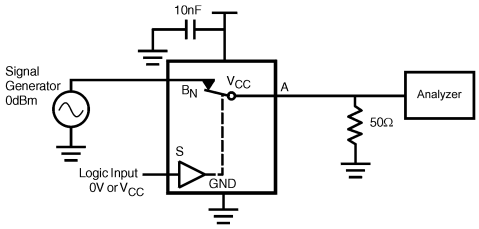
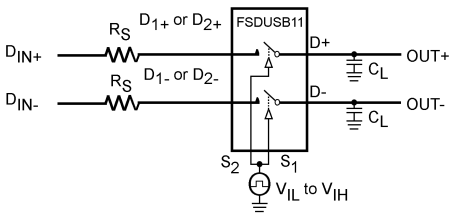


FIGURE 6. Bandwidth



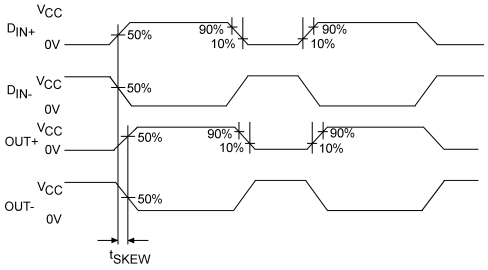


FIGURE 7. Skew Test

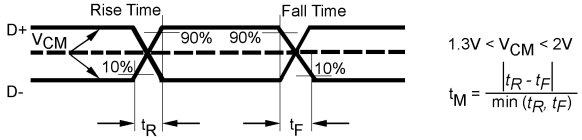
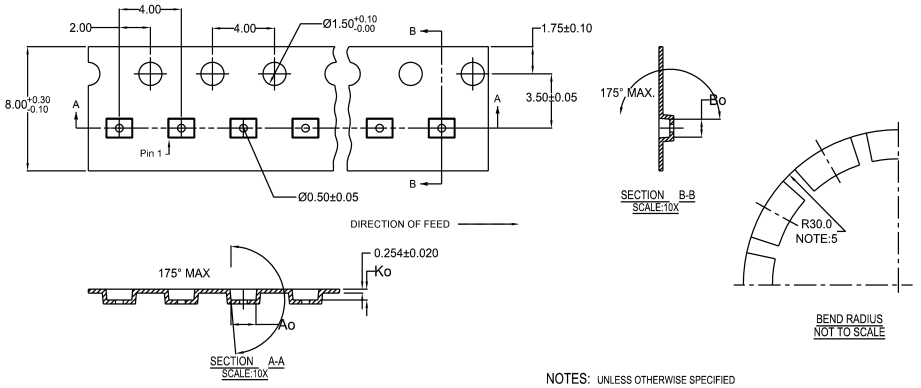


FIGURE 8. Rise/Fall Time Mismatch Test

Tape and Reel Specification

Tape Format For Micropak 10

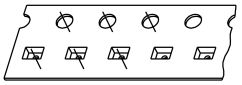
Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
L10X	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed



10	300056	2.30±0.05	1.78±0.05	0.68±0.05
8	300038	1.78±0.05	1.78±0.05	0.68±0.05
6	300033	1.60±0.05	1.15±0.05	0.70±0.05

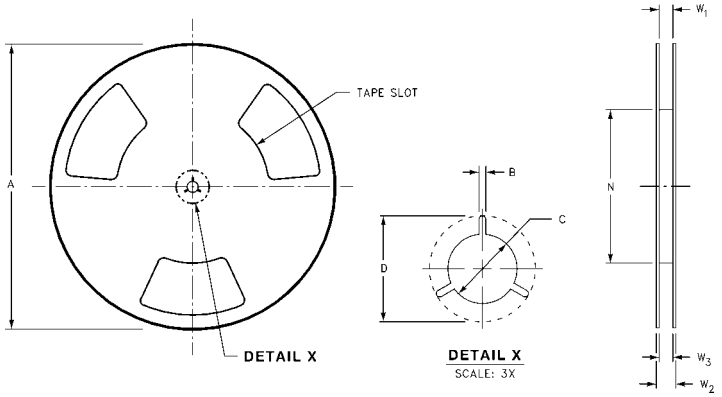
NOTES: UNLESS OTHERWISE SPECIFIED

1. ACCUMULATED 50 SPROCKETS, SPROCKET HOLE PITCH IS 200.00 ±0.30MM
2. NO INDICATED CORNER RADIUS IS 0.127MM
3. CAMBER NOT TO EXCEED 1MM IN 100MM
4. SMALLEST ALLOWABLE BENDING RADIUS
5. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE



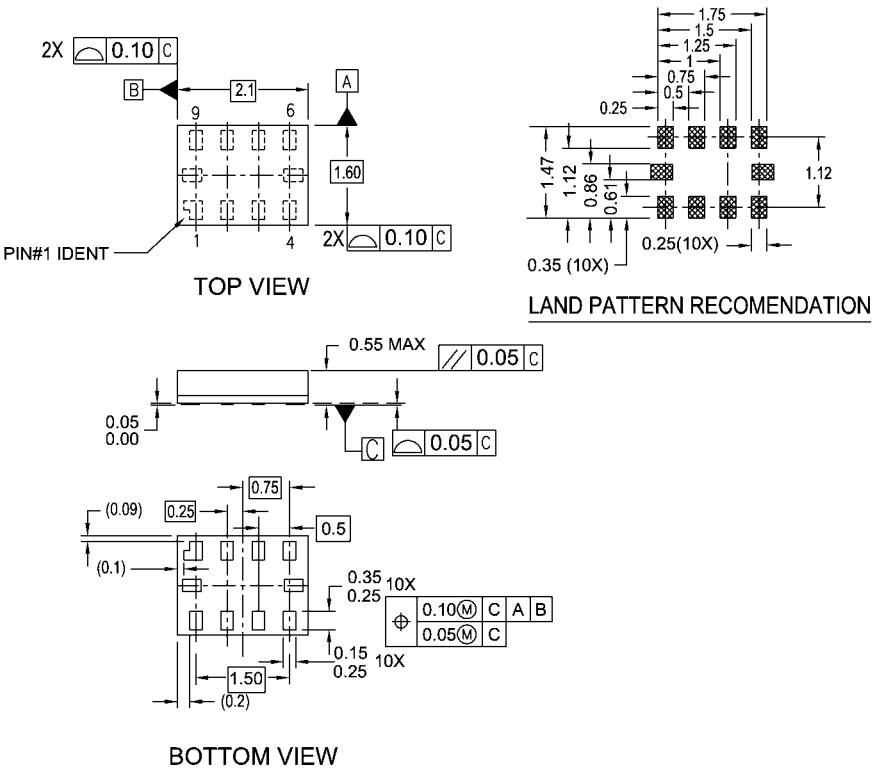
SCALE: 6X

REEL DIMENSIONS inches (millimeters)



Tape Size	A	B	C	D	N	W1	W2	W3
8 mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 + 0.059/–0.000 (8.40 + 1.50/–0.00)	0.567 (14.40)	W1 + 0.078/–0.039 (W1 + 2.00/–1.00)

Physical Dimensions inches (millimeters) unless otherwise noted



NOTES:

A. PACKAGE CONFORMS TO JEDEC MO255, VARIATION UABD

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCES CONFORMS TO ASME Y14.5M, 1994.

MAC010ARevB

10-Lead MicroPak, 1.6 mm x 2.1mm
Package Number MAC010A