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FAIRCHILD SEMICONDUCTOR®

April 2012

FSUSB73
3:1 High-Speed USB Multiplexer and Hub Routing Switch

Features

Switch Type	3:1 MUX + Isolation Switch
USB	USB 2.0 High-Speed & Full-Speed Compliant
R_{ON}	6.5Ω
C_{ON}	6pF
ESD (IEC61000-4-2)	15kV (Air), 8kV (Contact)
V_{CC}	2.5 to 4.4V
I_{CCSLP}	<1µA
I_{CCACT}	9µA
Package	16- Lead UMLP 1.8 x 2.6 x 0.55mm, 0.40mm Pitch
Ordering Information	FSUSB73UMX (UMLP)

Description

The FSUSB73 is a bi-directional, low-power, high-speed USB 2.0 3:1 MUX plus one isolation switch. It is optimized for switching three high-speed (480Mbps) or full / low-speed USB / UART sources to one USB 2.0 connector. In addition, the FSUSB73 has an integrated routing USB switch to allow communication between a USB hub and another processor without re-enumeration.

Related Resources

- *For samples and questions, please contact: Analog.Switch@fairchildsemi.com.*
- *FSUSB73 Demonstration Board*
- *FSUSB73 Evaluation Board*

Applications

- MP3 Portable Media Players
- Cellular Phones, Smartphones
- Netbook, Mobile Internet Device (MID)
- Enables USB Hub Switching

Typical Application

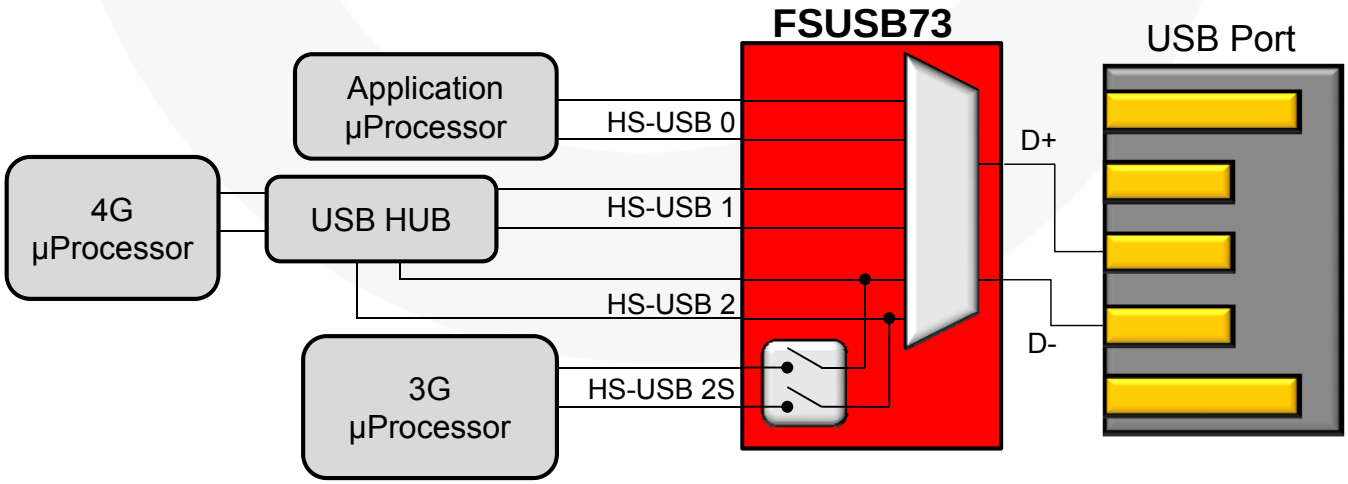


Figure 1. Mobile Phone Example

Pin Configuration

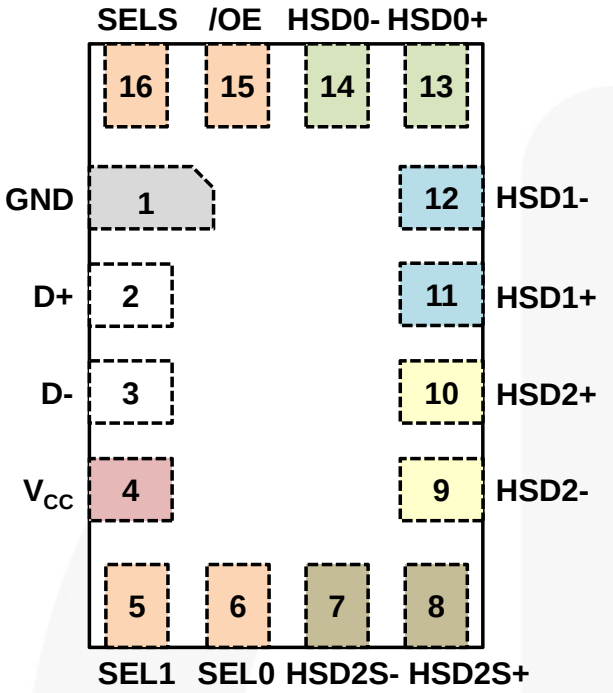


Figure 2. Pin Assignments (Top View)

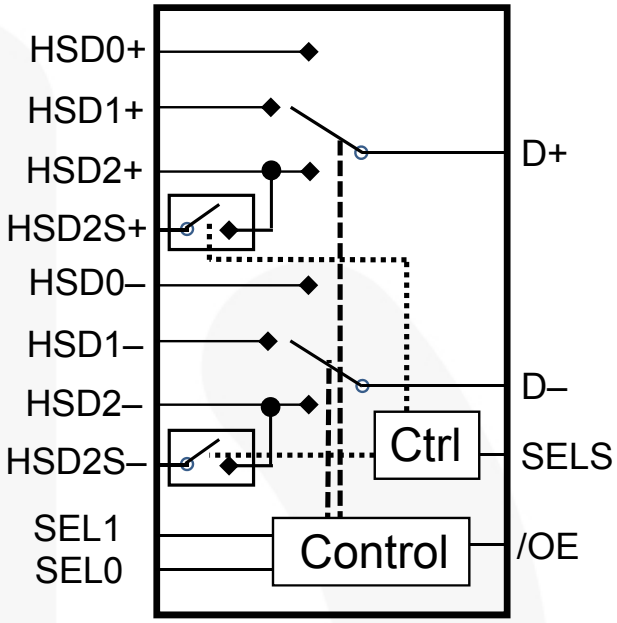


Figure 3. Analog Symbol

Pin Descriptions

Pin #	Name	Type	Description
1	GND	Ground	Ground
2	D+	I/O	D+ Common Port (HS or FS USB)
3	D-	I/O	D- Common Port (HS or FS USB)
4	V_{CC}	Power Supply	Supply Voltage
5	SEL1	Input	Path Selection Control Input *(see Truth Tables)*
6	SEL0	Input	Path Selection Control Input *(see Truth Tables)*
7	HSD2S-	I/O	HSD2- from Isolation Switch (HS or FS USB)
8	HSD2S+	I/O	HSD2+ from Isolation Switch (HS or FS USB)
9	HSD2-	I/O	D- from Third Source Path (HS or FS USB)
10	HSD2+	I/O	D+ from Third Source Path (HS or FS USB)
11	HSD1+	I/O	D+ from Second Source Path (HS or FS USB)
12	HSD1-	I/O	D- from Second Source Path (HS or FS USB)
13	HSD0+	I/O	D+ from First Source Path (HS or FS USB)
14	HSD0-	I/O	D- from First Source Path (HS or FS USB)
15	/OE	Input	Enable Control Input *(see Truth Tables)*
16	SELS	Input	Path Selection Control Input *(see Truth Table)*

Truth Tables

Table 1. 3:1 USB Switch Control

/OE	SEL1	SEL0	Function
1	X	X	All Switch Paths Open
0	0	1	D+ = HSD0+, D- = HSD0-
0	1	0	D+ = HSD1+, D- = HSD1-
0	1	1	D+ = HSD2+, D- = HSD2-
0	0	0	All Switch Paths Open

Table 2. Isolation Switch Control

SELS	Function
0	HSD2S+ = Open, HSD2S- = Open
1	HSD2S+ = HSD2+, HSD2S- = HS2S-

Functionality

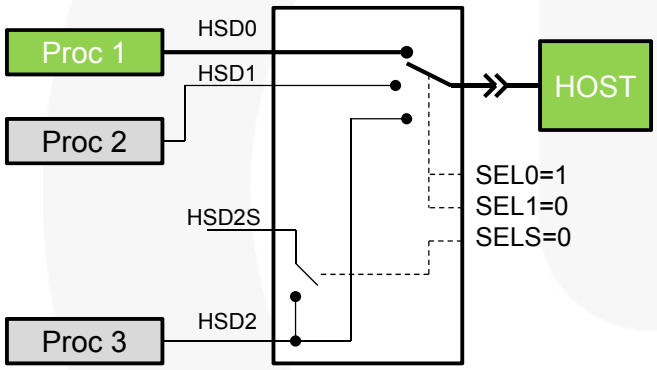


Figure 4. Typical USB Application 1

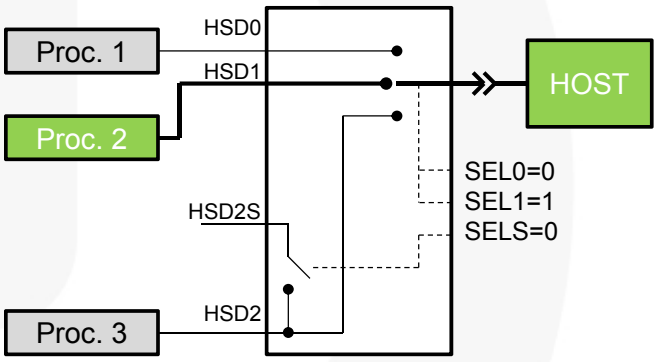


Figure 5. Typical USB Application 2

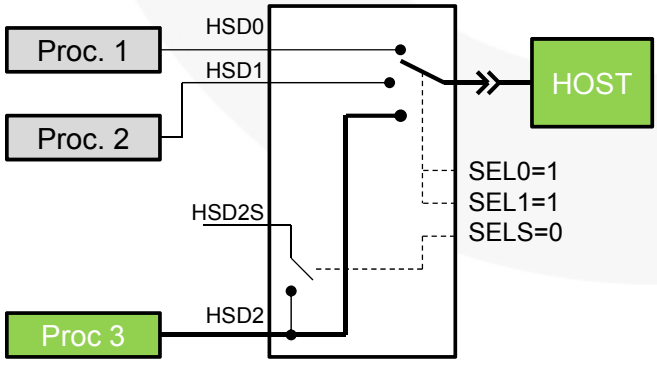


Figure 6. Typical USB Application 3

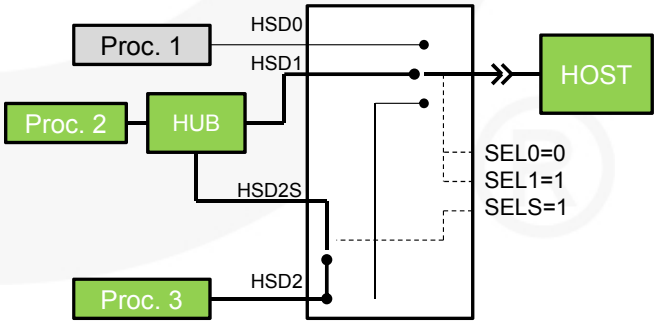


Figure 7. Loopback USB Application

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		-0.50	5.25	V
V_{CNTRL}	DC Input Voltage (SEL1, SEL0, /OE, SELS)(1)		-0.5	V_{CC}	V
V_{SW}	DC Switch I/O Voltage(1)		-0.50	5.25	V
I_{IK}	DC Input Diode Current		-50		mA
T_{STG}	Storage Temperature		-65	+150	°C
MSL	Moisture Sensitivity Level (JEDEC J-STD-020A)			1	Level
ESD	IEC61000-4-2 System on USB Connector Pins D+ & D-	Air Gap	15		kV
		Contact	8		
	Human Body Model, JEDEC: JESD22-A114	D+, D- to GND	6		
		Power to GND	12		
		All Other Pins	2		

Note:
1. 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	2.5	4.4	V
V_{CNTRL}	Control Input Voltage (SEL1, SEL0, /OE, and SELS)(2)	0	V_{CC}	V
V_{SW}	Switch I/O Voltage	-0.5	4.4	V
T_A	Operating Temperature	-40	+85	°C

Note:
2. The control input must be held HIGH or LOW; it must not float.

DC Electrical Characteristics

All typical values are for V_{CC}=3.3V at T_A=25°C unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	T_A=- 40ºC to +85ºC			Unit
				Min.	Typ.	Max.	
R_{ON}	HS Switch On Resistance(3)	V_{SW}=0.4V, I_{ON}=-8mA, Figure 8	3.3		6.5	9.0	Ω
ΔR_{ON}	HS Delta R_{ON}(4,3)	V_{SW}=0.4V, I_{ON}=-8mA	3.3		0.5		Ω
I_{IN}	Control Input Leakage	All Combinations of /OE, SELS, SEL1, SEL0 in Truth Tables *(Table 1, Table 2)* (1=V_{CC}, 0=0V)	4.4	-1		1	µA
I_{OZ}	Off State Leakage	0≤ Dn, HSD0n, HSD1n, HSD2n, HSD3n, HSD2Sn ≤ 4.4V	4.4	-1		1	µA
I_{OFF}	Power-Off Leakage Current (All I/O Ports)	V_{SW}=0V to 4.4V, V_{CC}=0V, Figure 9	0	-1		1	µA
I_{CCSLP}	Sleep Mode Supply Current	All Disabled Conditions in Truth Tables *(Table 1, Table 2)*	4.4			1	µA
I_{CCACT}	Active Mode Supply Current	All Active Modes in Truth Tables *(Table 1, Table 2)*	4.4		9	18	µA
I_{CCT}	Increase in I_{CC} Current per Control Input and V_{CC}	V_{CNTRL}=1.8V	4.4		3.3	4.0	µA
		V_{CNTRL}=1.2V	4.4		4.9	6.0	µA
V_{IK}	Clamp Diode Voltage	I_{IN}=-18mA	2.5			-1.2	V
V_{IH}	Control Input Voltage HIGH	SEL1, SEL0, /OE, SELS	2.5 to 4.4	1.0			V
V_{IL}	Control Input Voltage LOW	SEL1, SEL0, /OE, SELS	2.5 to 4.4			0.35	V

Notes:

3. Measured by the voltage drop between HSDn and Dn pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (HSDn or Dn ports).
4. Guaranteed by characterization.

AC Electrical Characteristics

All typical values are for V_{CC}=3.3V at T_A=25°C unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	T_A=- 40ºC to +85ºC			Unit
				Min.	Typ.	Max.	
t_{ON}	Turn-On Time when Switching from One USB Path (or Disabled i.e. /OE=1) to Another USB Path	R_L=50Ω, C_L=35pF, V_{SW}=0.8V, Figure 10, Figure 11	2.5 to 4.4	126		400	µs
t_{OFF}	Turn-Off Time, Turning Off Any of the USB Paths	R_L=50Ω, C_L=35pF, V_{SW}= 0.8V, Figure 10, Figure 11	2.5 to 4.4			80	ns
t_{PD}	Propagation Delay(5)	C_L=5pF, R_L=50Ω, Figure 10, Figure 12	3.3		0.25		ns
t_{RF}	Slow Turn on/off Switch Paths(5)	C_L=5pF, Dn at 0V or 3.6V, 40.5Ω in Series with Switch 10% to 90%	3.3		4.5		ns
t_{BBM}	Break-Before-Make Time(5)	R_L=50Ω, C_L=35pF, V_{SW1}=V_{SW2}= 0.8V, Figure 14	2.5 to 4.4	126		400	µs
O_{IRR}	Off Isolation(5)	R_L=50Ω, f=240MHz, Figure 16	2.5 to 4.4		-40		dB
Xtalk	Channel-to-Channel Crosstalk(5)	R_L=50Ω, f=240MHz, Figure 17	2.5 to 4.4		-40		dB
$t_{SK(P)}$	Pulse Skew(5)	V_{SW}=0.2V$diff_{PP}$, Figure 13, C_L=5pF	2.5 to 4.4		25		ps
$t_{SK(I)}$	Skew Between Differential Signals within a Pair(5)	V_{SW}=0.2V$diff_{PP}$, Figure 13, C_L=5pF	2.5 to 4.4		25		ps

Note:
5. Guaranteed by characterization.

Capacitance Characteristics

All typical values are for V_{CC}=3.3V at T_A=25°C unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	T_A=- 40ºC to +85ºC	Unit
				Typ.	
C_{IN}	Input Capacitance(6)		0	3.0	pF
C_{ONa}	D+/D- On Capacitance(6)	HSD0 or HSD1 path, f=1MHz, Figure 19	3.3	7.2	pF
C_{ONb}	D+/D- On Capacitance(6)	HSD2 path, f=1MHz, Figure 19	3.3	7.7	pF
C_{ONc}	D+/D- On Capacitance(6)	HSD2S to HSD2S path, f=1MHz, Figure 19	3.3	5.4	pF
C_{OFF}	HSD0n, HSD1n, HSD2Sn, HSD3n Off Capacitance(6)	If V_{CC}=3.3V, then /OE=3.3V, f=1MHz, Figure 18	0 or 3.3	2.2	pF

Note:
6. Guaranteed by characterization

Test Diagrams

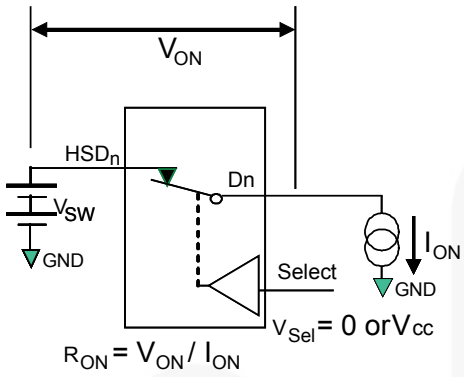
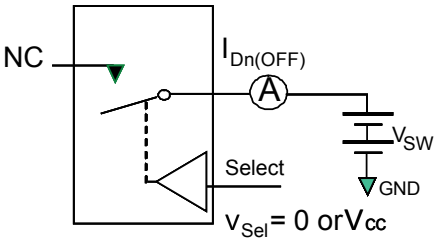
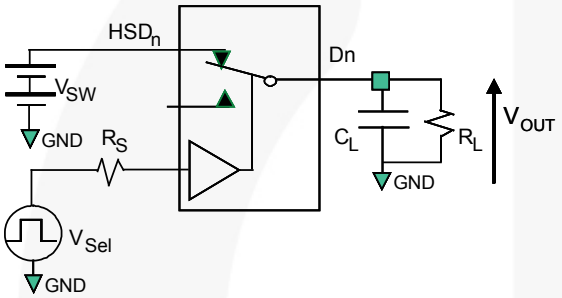


Figure 8. On Resistance



**Each switch port is tested separately

Figure 9. 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 10. AC Test Circuit Load

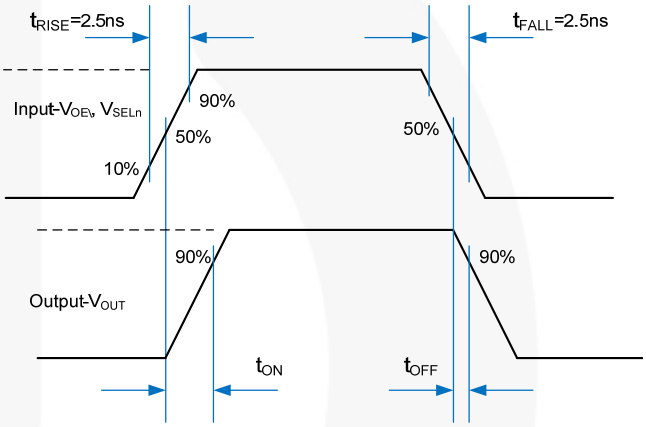


Figure 11. Turn-On / Turn-Off Waveforms

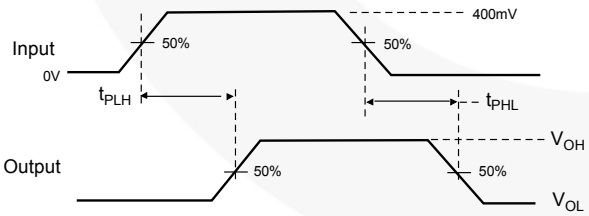


Figure 12. Propagation Delay ($t_R t_F$ – 500ps)

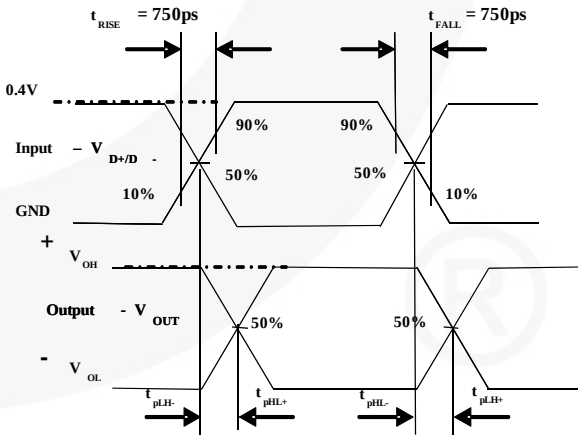
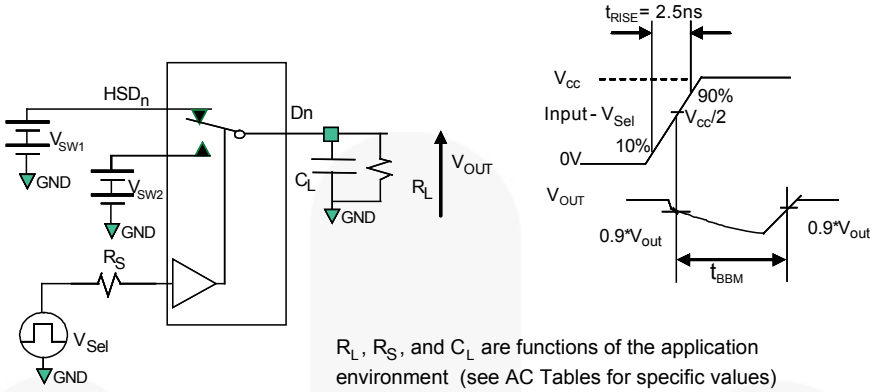


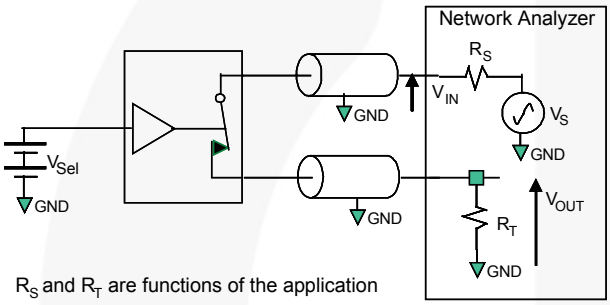
Figure 13. Skew Test Waveforms
$t_{SK(P)}$ = | t_{PLH-} – t_{PHL-} | or | t_{PLH+} – t_{PHL+} |
$t_{SK(I)}$ = | t_{PLH-} – t_{PHL+} | or | t_{PLH+} – t_{PHL-} |

Test Diagrams (Continued)



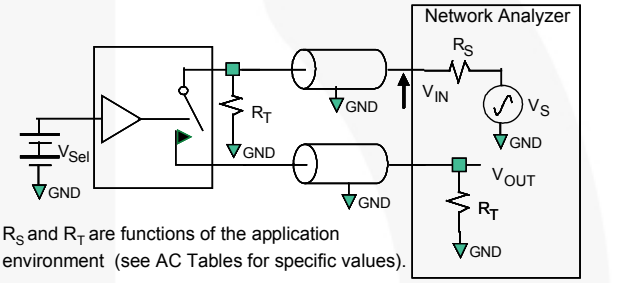
R_L, R_S, and C_L are functions of the application environment (see AC Tables for specific values)
C_L includes test fixture and stray capacitance.

Figure 14. Break-Before-Make Interval Timing



R_S and R_T are functions of the application environment (see AC Tables for specific values).

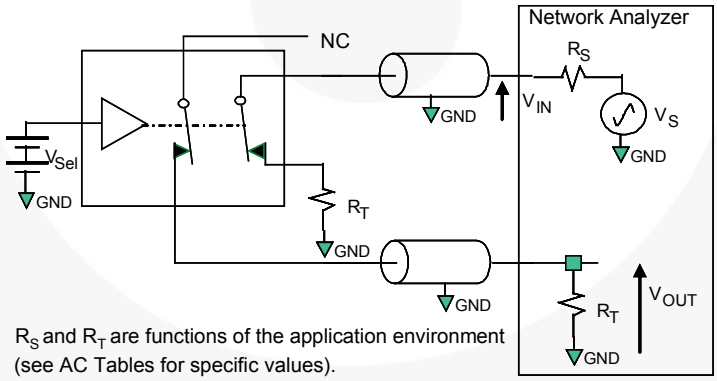
Figure 15. Bandwidth



R_S and R_T are functions of the application environment (see AC Tables for specific values).

Off isolation = 20 Log (V_{OUT} / V_{IN})

Figure 16. Channel-Off Isolation



R_S and R_T are functions of the application environment (see AC Tables for specific values).

Crosstalk = 20 Log (V_{OUT} / V_{IN})

Figure 17. Non-Adjacent Channel-to-Channel Crosstalk

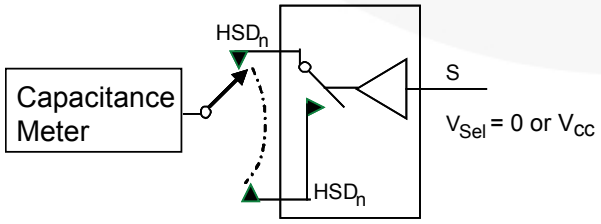


Figure 18. Channel Off Capacitance

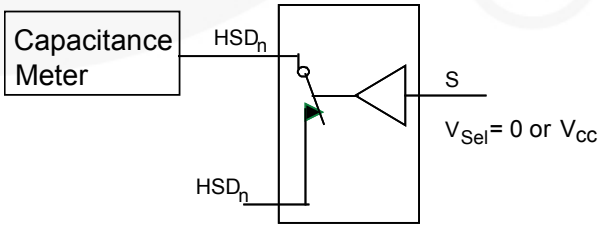
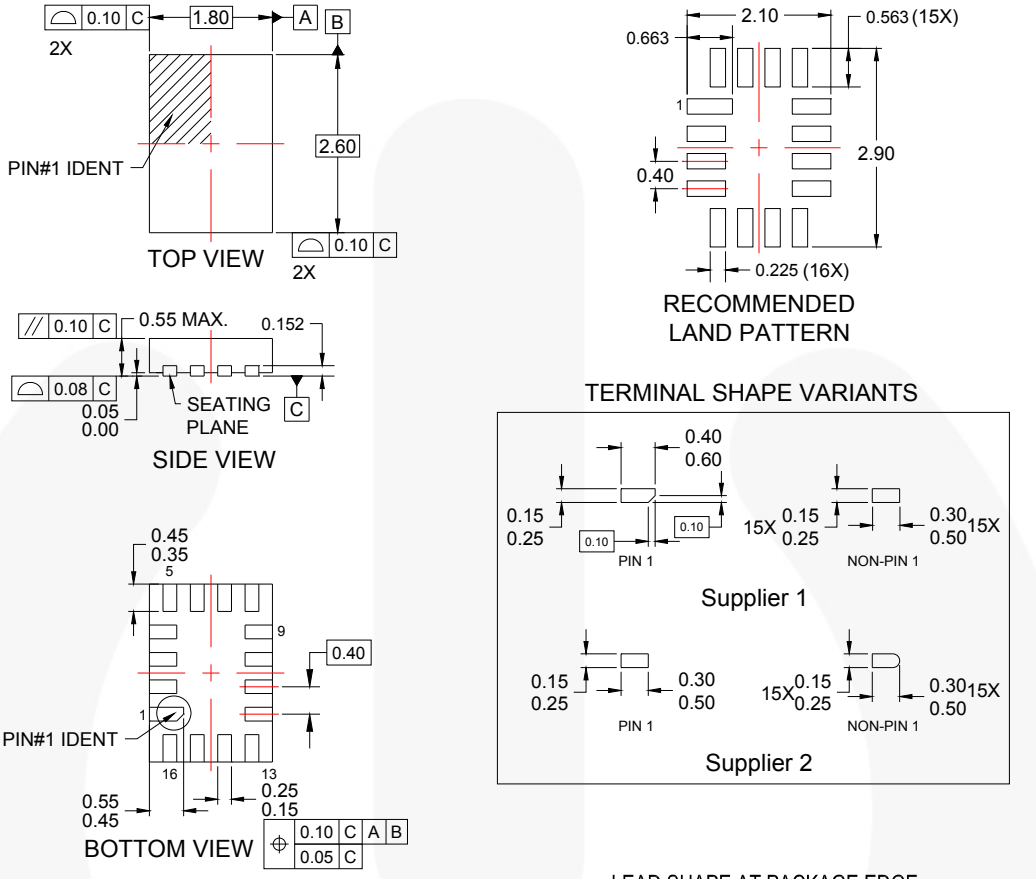


Figure 19. Channel On Capacitance

Physical Dimensions



NOTES:

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B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
D. LAND PATTERN RECOMMENDATION IS BASED ON FSC DESIGN ONLY.
E. DRAWING FILENAME: MKT-UMLP16Arev4.
F. TERMINAL SHAPE MAY VARY ACCORDING TO PACKAGE SUPPLIER, SEE TERMINAL SHAPE VARIANTS.

Figure 20. 16-Pin Ultrathin Molded Leadless Package (UMLP)

Order Number	Operating Temperature Range	Package Description	Packing Method
FSUSB73UMX	-40 to 85°C	16-Terminal Ultrathin Molded Leadless Package (UMLP)	Tape & Reel

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

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SMART START™
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STEALTH™
SuperFET®
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™
Sync-Lock™
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the power franchise
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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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Definition of Terms

Datasheet Identification	Product Status	Definition
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