FAIRCHILD SEMICONDUCTOR®

August 2010

FSUSB42 — Low-Power, Two-Port, Hi-Speed, USB2.0 (480Mbps) UART Switch

Features

- Low On Capacitance: 3.7pF Typical
- Low On Resistance: 3.9Ω Typical
- Low Power Consumption: 1µA Maximum
  - 15µA Maximum I_{CCT} over an Expanded Voltage Range (V_{IN}=1.8V, V_{CC}=4.4V)
- Wide -3db Bandwidth: > 720MHz
- Packaged in:
  - 10-Lead UMLP (1.4 x 1.8mm)
  - 10-Lead MSOP
- 8kV ESD Rating, >16kV Power/GND ESD Rating
- Over-Voltage Tolerance (OVT) on all USB Ports Up to 5.25V without External Components

Applications

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

IMPORTANT NOTE:

For additional performance information, please contact analogswitch@fairchildsemi.com.

Description

The FSUSB42 is a bi-directional, low-power, two-port, Hi-Speed, USB2.0 switch. Configured as a double-pole, double-throw switch (DPDT) switch, it is optimized for switching between two Hi-Speed (480Mbps) sources or a Hi-Speed and Full-Speed (12Mbps) source.

The FSUSB42 is compatible with the requirements of USB2.0 and features an extremely low on capacitance (C_{ON}) of 3.7pF. The wide bandwidth of this device (720MHz) exceeds the bandwidth needed to pass the third harmonic, resulting in signals with minimum edge and phase distortion. Superior channel-to-channel crosstalk also minimizes interference.

The FSUSB42 contains special circuitry on the switch I/O pins for applications where the V_{CC} supply is powered-off (V_{CC}=0), 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 SEL 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 and connector sharing in portable cell phones, PDAs, digital cameras, printers, and notebook computers.

Ordering Information

Part Number	Top Mark	Operating Temperature Range	Package
FSUSB42UMX	HE	-40 to +85°C	10-Lead, Quad, Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8mm
FSUSB42MUX	FSUSB42	-40 to +85°C	10-Lead, Molded Small Outline Package (MSOP) JEDEC MO-187, 3.0mm Wide

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

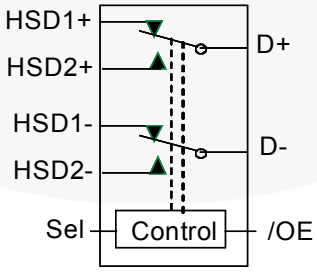


Figure 1. Analog Symbol

Pin Assignments

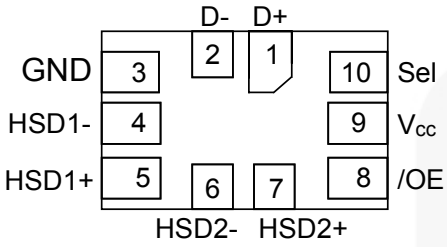


Figure 2. Pin Assignment 10L UMLP (Top Through View)

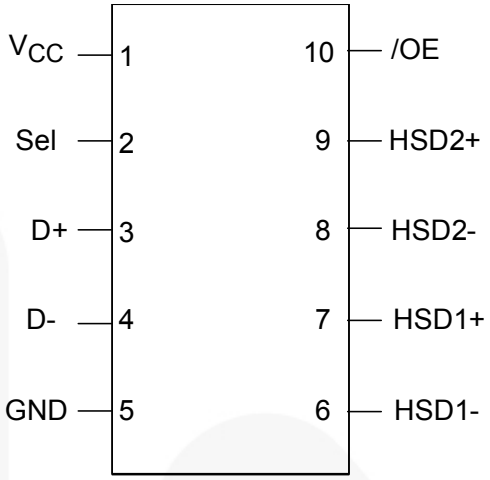


Figure 3. Pin Assignment 10L MSOP (Top Through View)

Pin Definitions

UMLP Pin#	MSOP Pin#	Name	Description
1	3	D+	USB Data Bus
2	4	D-	USB Data Bus
3	5	GND	Ground
4	6	HSD1-	Multiplexed Source Inputs (UART / USB)
5	7	HSD1+	Multiplexed Source Inputs (UART / USB)
6	8	HSD2-	Multiplexed Source Inputs (USB Only)
7	9	HSD2+	Multiplexed Source Inputs (USB Only)
8	10	/OE	Switch Enable
9	1	V_{CC}	Supply Voltage
10	2	Sel	Switch Select

Truth Table

Sel	/OE	Function
X	HIGH	Disconnect
LOW	LOW	D+, D-=HSD1+, HSD1-
HIGH	LOW	D+, D-=HSD2+, HSD2-

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	5.6	V
V_{CNTRL}	DC Input Voltage (S, /OE)[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
I_{OUT}	DC Output Current			100	mA
T_{STG}	Storage Temperature		-65	+150	°C
MSL	Moisture Sensitivity Level (JEDEC J-STD-020A)			1	Level
ESD	Human Body Model, JEDEC: JESD22-A114	All Pins		7	kV
		I/O to GND		8	
		Power to GND		16	
	Charged Device Model, JEDEC: JESD22-C101			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	3.0	4.4	V
V_{CNTRL}[2]	Control Input Voltage (S, /OE)	0	V_{CC}	V
V_{SW}	Switch I/O Voltage	-0.5	4.5	V
T_A	Operating Temperature	-40	+85	°C

Note:

2. 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°C unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	T_A=- 40ºC to +85ºC			Units
				Min.	Typ.	Max.	
V_{IK}	Clamp Diode Voltage	I_{IN}=-18mA	3.0			-1.2	V
V_{IH}	Input Voltage High		3.0 to 3.6	1.3			V
			4.3	1.7			V
V_{IL}	Input Voltage Low		3.0 to 3.6			0.5	V
			4.3			0.7	V
I_{IN}	Control Input Leakage	V_{SW}=0 to V_{CC}	0 to 4.3	-1		1	µA
I_{OZ}	Off State Leakage	0 ≤ Dn, HSD1n, HSD2n ≤ 3.6V	4.3	-2		2	µA
I_{OFF}	Power-Off Leakage Current (All I/O Ports)	V_{SW}=0V to 4.3V, V_{CC}=0V Figure 5	0	-2		2	µA
R_{ON}	HS Switch On Resistance(3)	V_{SW}=0.4V, I_{ON}=-8mA Figure 4,	3.0		3.9	6.5	Ω
ΔR_{ON}	HS Delta R_{ON}(4)	V_{SW}=0.4V, I_{ON}=-8mA	3.0		0.65		Ω
I_{CC}	Quiescent Supply Current	V_{CNTRL}=0 or V_{CC}, I_{OUT}=0	4.3			1	µA
I_{CCT}	Increase in I_{CC} Current per Control Voltage and V_{CC}	V_{CNTRL}=2.6V, V_{CC}=4.3V	4.3			10	µA
		V_{CNTRL}=1.8V, V_{CC}=4.3V	4.3			15	µA

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 value 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			Units
				Min.	Typ.	Max.	
t_{ON}	Turn-On Time S, /OE to Output	R_L=50Ω, C_L=5pF V_{SW}=0.8V Figure 6, Figure 7	3.0 to 3.6		13	30	ns
t_{OFF}	Turn-Off Time S, /OE to Output	R_L=50Ω, C_L=5pF V_{SW}=0.8V Figure 6, Figure 7	3.0 to 3.6		12	25	ns
t_{PD}	Propagation Delay(5)	C_L=5 pF, R_L=50Ω Figure 6, Figure 8	3.3		0.25		ns
t_{BBM}	Break-Before-Make	R_L=50Ω, C_L=5pF V_{SW1}=V_{SW2}=0.8V Figure 10	3.0 to 3.6	2.0		6.5	ns
O_{IRR}	Off Isolation	R_L=50Ω, f=240MHz Figure 12	3.0 to 3.6		-30		dB
Xtalk	Non-Adjacent Channel Crosstalk	R_L=50Ω, f=240MHz Figure 13	3.0 to 3.6		-45		dB
BW	-3db Bandwidth	R_L=50Ω, C_L=0pF Figure 11	3.0 to 3.6		720		MHz
		R_L=50Ω, C_L=5pF Figure 11			550		MHz

Note:

5. Guaranteed by characterization.

USB Hi-Speed-Related AC Electrical Characteristics

Symbol	Parameter	Conditions	Vcc (V)	T_A=- 40ºC to +85ºC			Units
				Min.	Typ.	Max.	
$t_{SK(P)}$	Skew of Opposite Transitions of the Same Output(6)	C_L=5pF, R_L=50Ω Figure 9	3.0 to 3.6		20		ps
t_J	Total Jitter(6)	R_L=50Ω, C_L=5pf, t_R=t_F=500ps (10-90%) at 480Mbps (PRBS=2^{15} – 1)	3.0 to 3.6		200		ps

Note:

6. Guaranteed by characterization.

Capacitance

Symbol	Parameter	Conditions	T_A=- 40ºC to +85ºC			Units
			Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance	V_{CC}=0V		1.5		pF
C_{ON}	D+/D- On Capacitance	V_{CC}=3.3V, /OE=0V, f=240MHz Figure 15		3.7		
C_{OFF}	D1n, D2n Off Capacitance	V_{CC} and /OE=3.3V Figure 14		2.0		

Test Diagrams

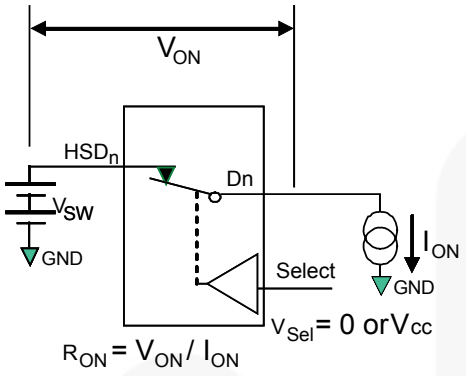
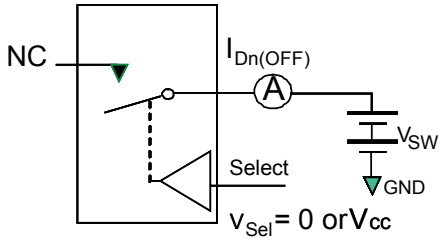
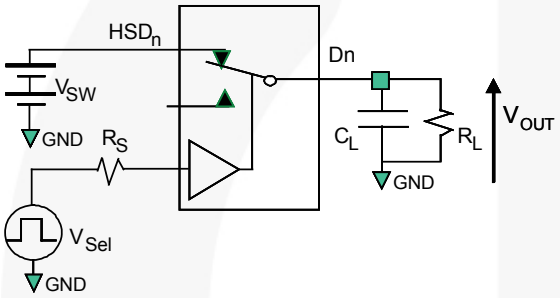


Figure 4. On Resistance



**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

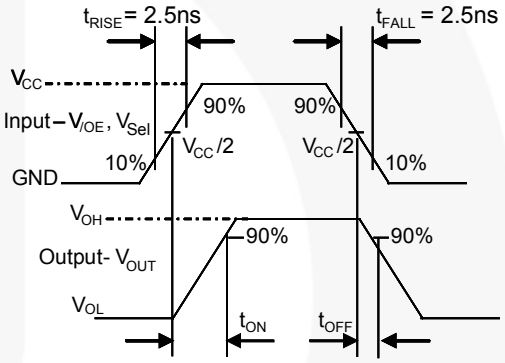


Figure 7. Turn-On / Turn-Off Waveforms

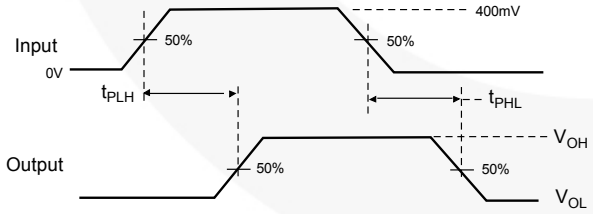


Figure 8. Propagation Delay ($t_R t_F$ – 500ps)

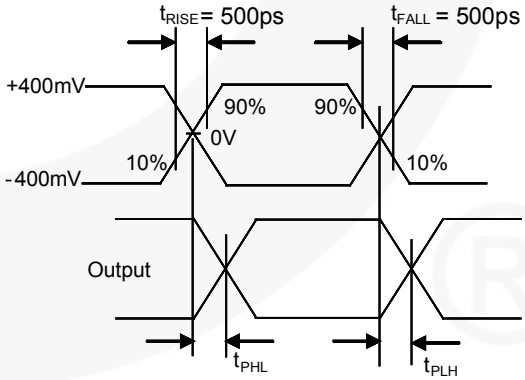
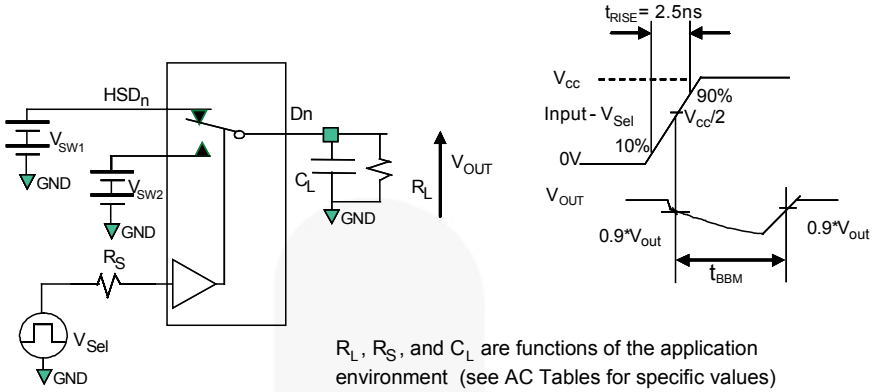


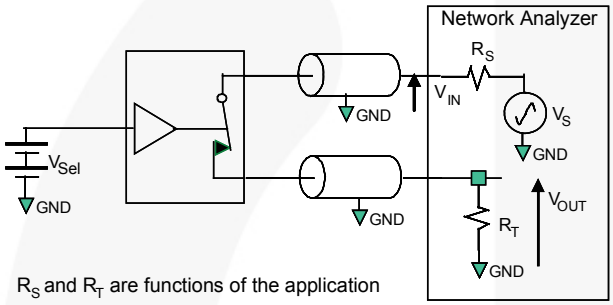
Figure 9. Intra-Pair Skew Test $t_{SK(P)}$

Test Diagrams (Continued)



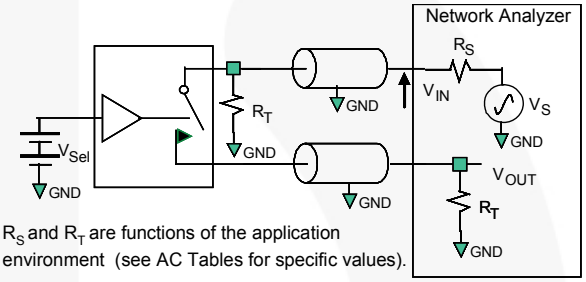
R_L, R_S, and C_L are functions of the application environment (see AC Tables for specific values)
C_L includes test fixture and stray capacitance.

Figure 10. Break-Before-Make Interval Timing



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

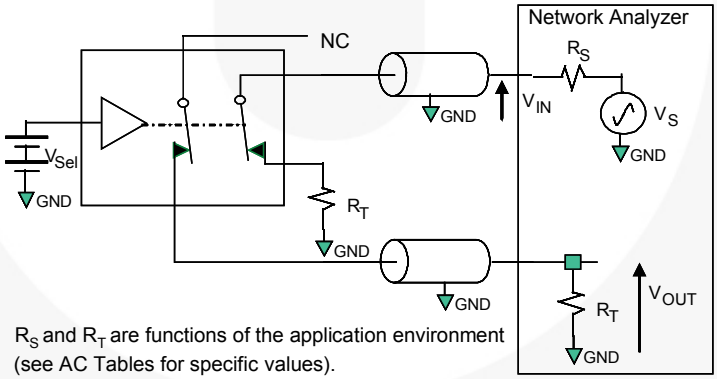
Figure 11. Bandwidth



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 12. 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 13. Non-Adjacent Channel-to-Channel Crosstalk

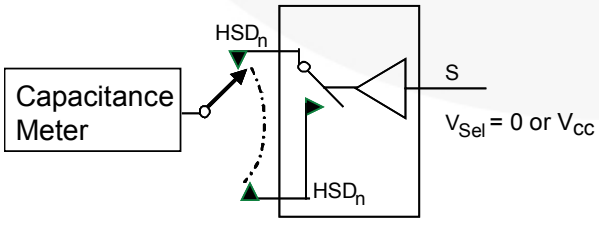


Figure 14. Channel Off Capacitance

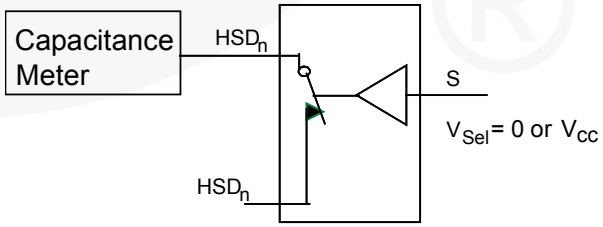
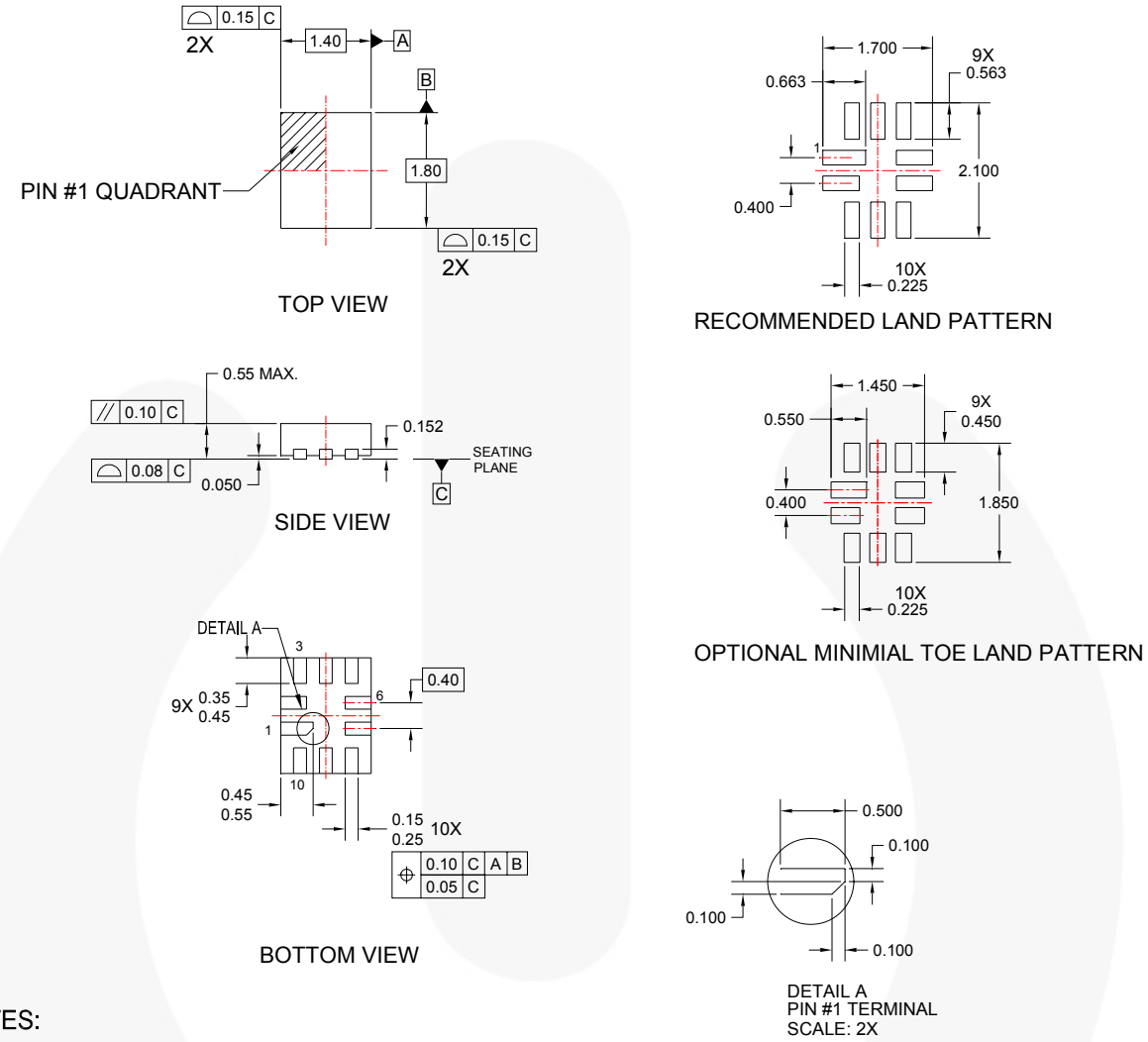


Figure 15. Channel On Capacitance

Physical Dimensions



NOTES:

A. DIMENSIONS ARE IN MILLIMETERS.

B. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

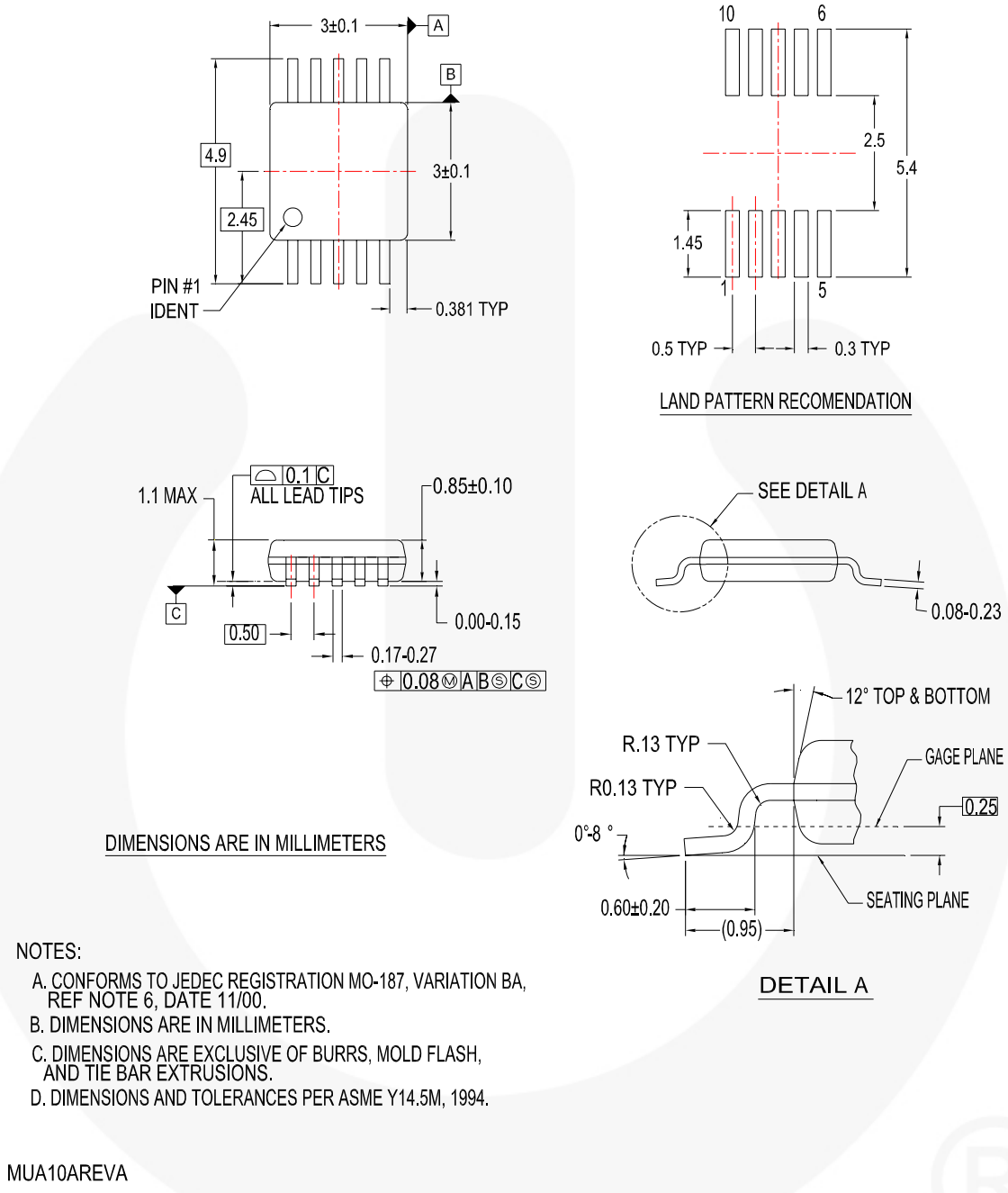
C. DRAWING FILENAME: UMLP10Arev2

Figure 16. 10-Lead, Ultrathin Molded Leadless Package (UMLP)

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.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:
http://www.fairchildsemi.com/packaging/.

Physical Dimensions (Continued)



NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-187, VARIATION BA, REF NOTE 6, DATE 11/00.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

D. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.

MUA10AREVA

Figure 17. 10-Lead, Molded Small Outline Package (MSOP)

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.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:
http://www.fairchildsemi.com/packaging/.

FAIRCHILD SEMICONDUCTOR®

TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

AccuPower™
Auto-SPM™
Build it Now™
CorePLUS™
CorePOWER™
CROSSVOLT™
CTL™
Current Transfer Logic™
DEUXPEED®
Dual Cool™
EcoSPARK®
EfficientMax™
ESBC™
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FETBench™
FlashWriter®*
FPS™
F-PFS™
FRFET®
Global Power Resource℠
Green FPS™
Green FPS™ e-Series™
Gmax™
GTO™
IntelliMAX™
ISOPLANAR™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MicroPak2™
MillerDrive™
MotionMax™
Motion-SPM™
OptoHiT™
OPTOLOGIC®
OPTOPLANAR®
PDP SPM™
Power-SPM™
PowerTrench®
PowerXS™
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
Saving our world, 1mW/W/kW at a time™
SignalWise™
SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™
Sync-Lock™
SYSTEM GENERAL®*
The Power Franchise®
TinyBoost™
TinyBuck™
TinyCalc™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TriFault Detect™
TRUECURRENT™*
µSerDes™
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
XS™

* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
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.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I49