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FSUSB46 — Hi-Speed USB2.0 (480Mbps) DPST Switch with Dedicated Charger Port Detection

Features

- Low On Capacitance: 7.0pF Typical
- Low On Resistance: 3.9Ω Typical
- Low Power Consumption: 1μA Maximum
 - 15μA Maximum I_{CCT} over an Expanded Voltage Range ($V_{IN}=1.8V$, $V_{CC}=4.3V$)
- Wide -3db Bandwidth: > 720MHz
- Packaged in Pb-free, 8-Lead MicroPak™ (1.6mm wide), US8 (3.1mm wide), and UMLP (1.4x1.4mm)
- 8kV ESD Rating, >16kV Power/GND ESD Rating
- Power-Off Protection on All Ports When $V_{CC}=0V$
 - D+/D- Pins Tolerate up to 5.25V

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 FSUSB46 is a bi-directional, low-power, Hi-Speed, USB2.0 switch. Configured as a double-pole, single-throw switch (DPST) switch, it is optimized for switching a Hi-Speed (480Mbps) source.

The FSUSB46 is compatible with the requirements of USB2.0 and features an extremely low on capacitance (C_{ON}) of 3.9pF. 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 FSUSB46 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 /OE 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. An additional feature is the detection of the 1-1 (high/high) state on D+/D- to signal an interrupt (INT) to the processor when entering a dedicated charging port mode of operation.

Ordering Information

Part Number	Operating Temperature Range	Package	Eco Status
FSUSB46L8X	-40 to +85°C	8-Lead MicroPak™ 1.6mm Wide	RoHS
FSUSB46K8X	-40 to +85°C	8-Lead US8, JEDEC MO187, Variation CA 3.1mm	Green
FSUSB46UMX	-40 to +85°C	8-Lead Ultrathin Molded Leadless Package (UMLP), 1.2 x 1.4mm	Green

For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

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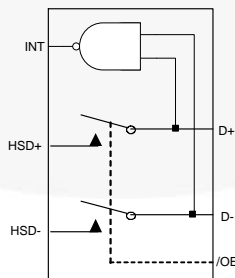
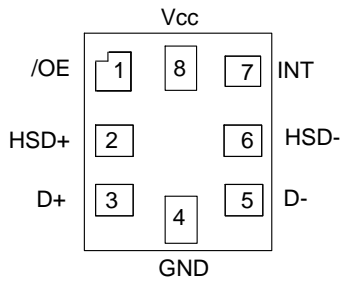
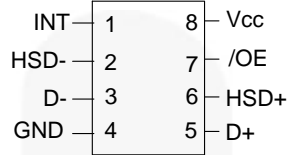


Figure 1. Analog Symbol

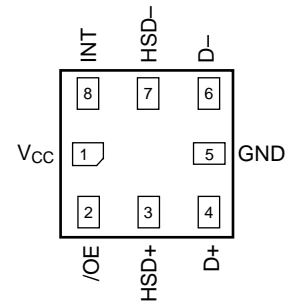
Pin Configurations



**Figure 2. MicroPak™
(Top Through View)**



**Figure 3. US8
(Top Through View)**



**Figure 4. UMLP
(Top Through View)**

Pin Definitions

Pin Name	Description
INT	Interrupt Signaling Output Pin
/OE	Switch Enable
D+, D-	USB Data Bus Connector
HSD+, HSD-	USB Source Inputs
GND	Ground
V _{cc}	Supply Voltage

Truth Table

Data Path		Charger Detect Path	
/OE	Switch Connection	D+ D-	INT Output
HIGH	D+, D- = Open	1-1	LOW
LOW	D+, D- = HSD+, HSD-	0X, X0	HIGH

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	+5.5	V
V_{CNTRL}	DC Input Voltage (S) ⁽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		50	mA
T_{STG}	Storage Temperature	-65	+150	°C
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	4.3	V
V_{CNTRL}	Control Input Voltage (/OE) ⁽²⁾	0	V_{CC}	V
V_{SW}	Switch I/O Voltage	-0.5	V_{CC}	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 value are at 25°C, V_{CC}=3.3V unless otherwise specified.

Symbol	Parameter	Conditions	V _{CC} (V)	T _A =- 40°C to +85°C			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
V _{OH}	Output Voltage High	I _{OH} =-2mA	3.0 to 3.6	2.4			V
			4.3	2.4			V
V _{OL}	Output Voltage Low	I _{OL} =2mA	3.0 to 3.6			0.25	V
			4.3			0.25	V
I _{IN}	Control Input Leakage	V _{SW} =0 to V _{CC}	4.3	-1		1	μA
I _{OZ}	Off State Leakage	HSD+ or HSD-=0V, 3.6V or floating	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 6	0	-2		2	μA
R _{ON}	HS Switch On Resistance ⁽³⁾	V _{SW} =0.4V, I _{ON} =-8mA Figure 5	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			20	μA

Notes:

- 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).
- Guaranteed by characterization.

AC Electrical Characteristics

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

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A=-40^{\circ}C$ to $+85^{\circ}C$			Units
				Min.	Typ.	Max.	
t_{ON}	Turn-On Time /OE to Output	$R_L=50\Omega$, $C_L=5pF$ $V_{SW}=0.8V$ Figure 7, Figure 8	3.0 to 3.6		13	30	ns
t_{OFF}	Turn-Off Time /OE to Output	$R_L=50\Omega$, $C_L=5pF$ $V_{SW}=0.8V$ Figure 7, Figure 8	3.0 to 3.6		12	25	ns
t_{PD}	Propagation Delay ⁽⁵⁾	$C_L=5 pF$, $R_L=50\Omega$ Figure 7, Figure 9	3.3		0.25		ns
t_{BBM}	Break-Before-Make	$R_L=50\Omega$, $C_L=5pF$ $V_{SW1}=V_{SW2}=0.8V$ Figure 13	3.0 to 3.6	2.0		6.5	ns
$t_{PLH/HL}$	INT Propagation Delay ⁽⁵⁾	$R_L=500\Omega$, $C_L=5pF$	3.0 to 3.6		10		ns
O_{IRR}	Off Isolation	$R_L=50\Omega$, $f=240MHz$ Figure 15	3.0 to 3.6		-30		dB
Xtalk	Non-Adjacent Channel Crosstalk	$R_L=50\Omega$, $f=240MHz$ Figure 16	3.0 to 3.6		-45		dB
BW	-3db Bandwidth	$R_L=50\Omega$, $C_L=0pF$ Figure 14	3.0 to 3.6		720		MHz
		$R_L=50\Omega$, $C_L=5pF$ Figure 14			550		MHz

Note:

5. Guaranteed by characterization.

USB Hi-Speed-Related AC Electrical Characteristics

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

Note:

6. Guaranteed by characterization.

Capacitance

Symbol	Parameter	Conditions	$T_A=-40^{\circ}C$ to $+85^{\circ}C$			Units
			Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance	$V_{CC}=0V$		1.5		pF
C_{OUT}	INT Pin Output Capacitance	$V_{CC}=0V$		2.5		pF
C_{ON}	D+, D- On Capacitance	$V_{CC}=3.3V$, $f=1MHz$ Figure 12		7.0	7.9	pF
C_{OFF}	D+, D- Off Capacitance	$V_{CC}=3.3V$ Figure 11		2.0		pF

Test Diagrams

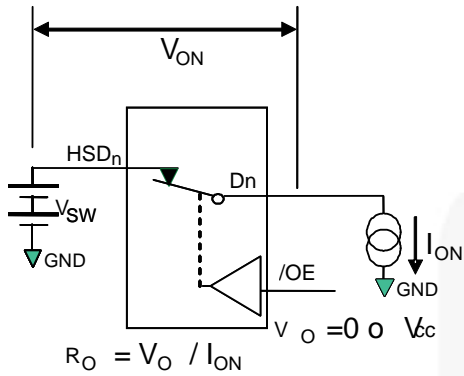


Figure 5. On Resistance

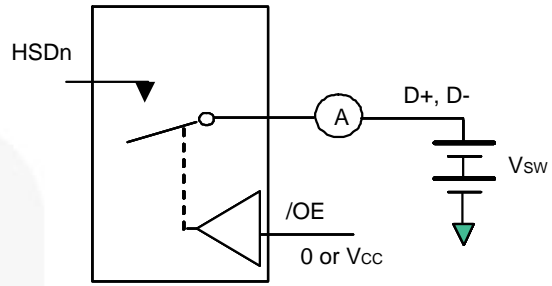
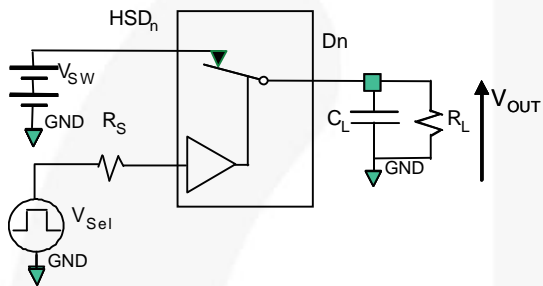


Figure 6. Off/On Leakage



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 7. AC Test Circuit Load

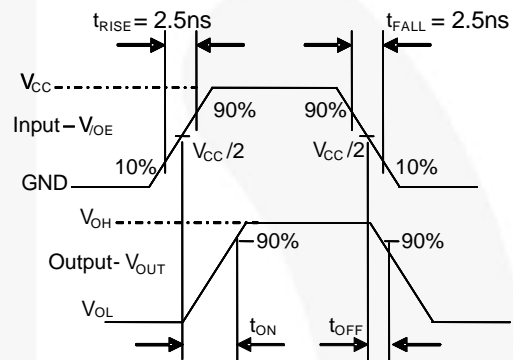


Figure 8. Turn-On / Turn-Off Waveforms

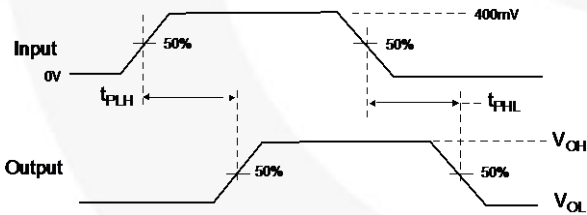


Figure 9. Propagation Delay ($t_{r,t_f} = 500ps$)

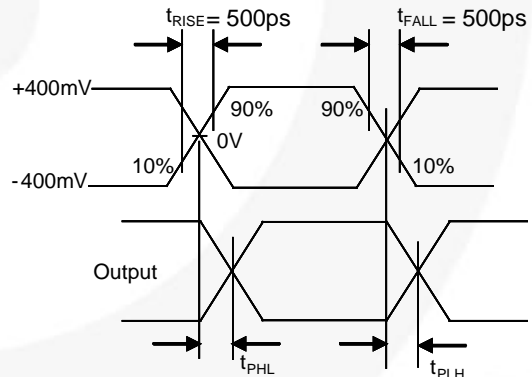


Figure 10. Intra-Pair Skew Test $t_{SK(P)}$

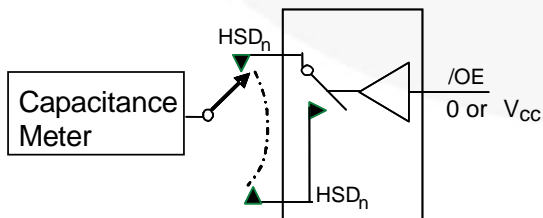


Figure 11. Channel Off Capacitance

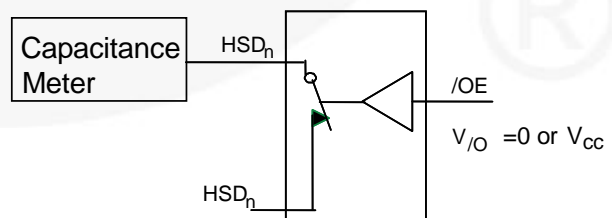
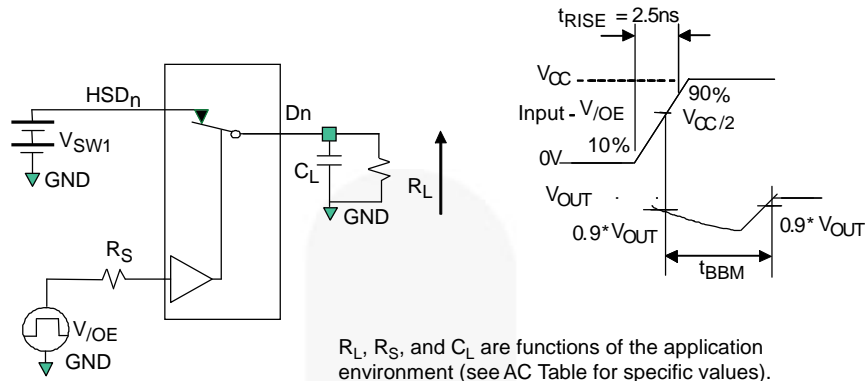


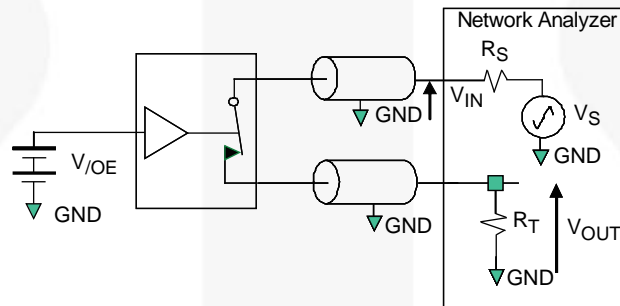
Figure 12. Channel On Capacitance

Test Diagrams (Continued)



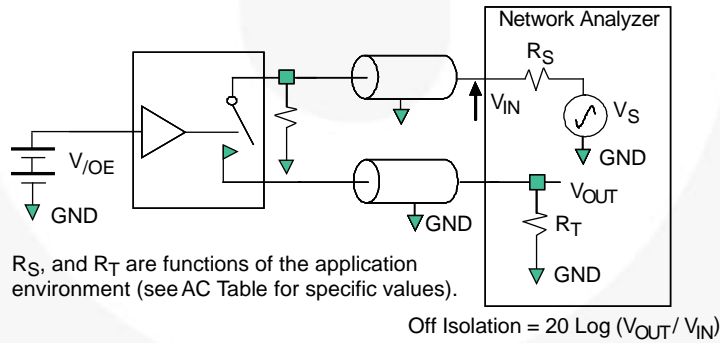
R_L , R_S , and C_L are functions of the application environment (see AC Table for specific values). C_L includes text figure and stray capacitance.

Figure 13. Break-Before-Make Interval Timing



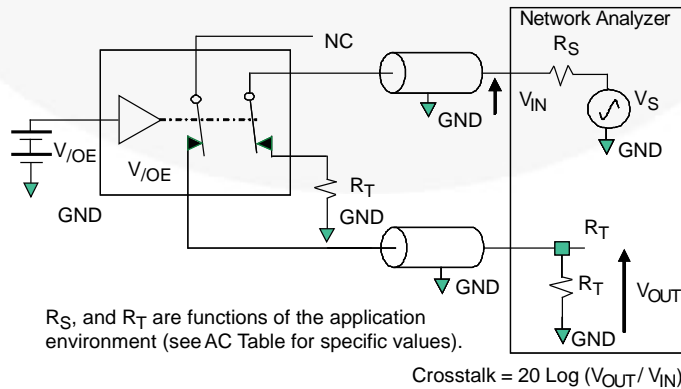
R_S , and R_T are functions of the application environment (see AC Table for specific values).

Figure 14. Bandwidth



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

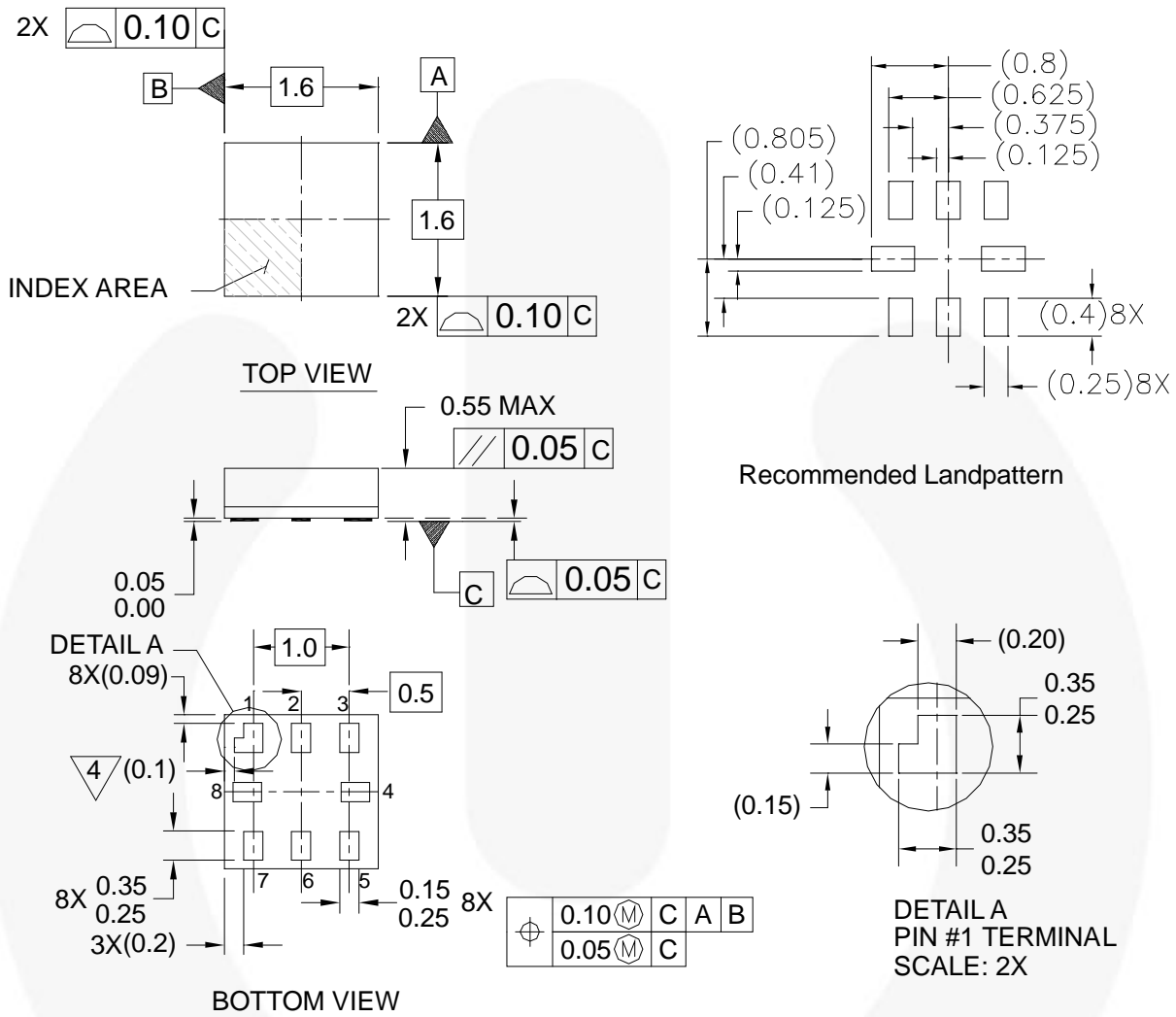
Figure 15. Channel Off Isolation



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

Figure 16. Non-Adjacent Channel-to-Channel Crosstalk

Physical Dimensions



Notes:

1. PACKAGE CONFORMS TO JEDEC MO-255 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y.14M-1994
4. PIN 1 FLAG, END OF PACKAGE OFFSET
5. DRAWING FILE NAME: MKT-MAC08AREV4

MAC08AREV4

Figure 17. 8-Lead MicroPak™

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Tape and Reel Specifications

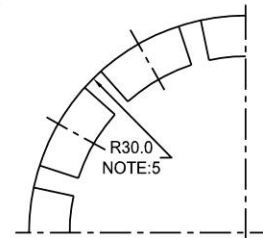
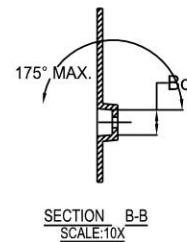
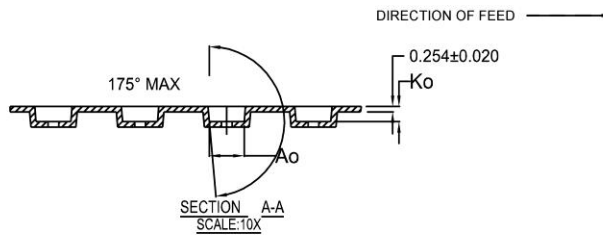
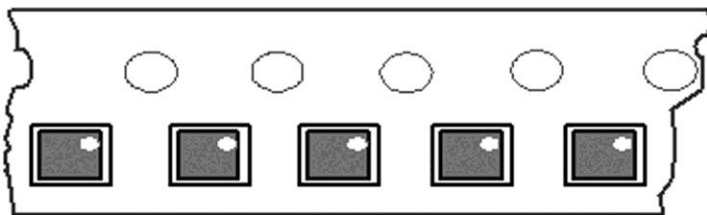
Package Designator	Tape Section	Cavity Number	Cavity Status	Cover Tape Status
L6X, L8X, L10X	Leader (Start End)	125 (Typical)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (Typical)	Empty	Sealed

Standard Tape and Reel Specifications

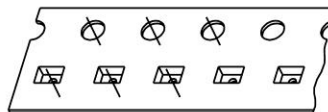
Standard tape and reel specifications for MicroPak are available at Fairchild Semiconductor's website:

http://www.fairchildsemi.com/products/logic/pdf/micropak_tr.pdf

FSUSB46L8X_F130 Tape and Reel Specifications



BEND RADIUS
NOT TO SCALE



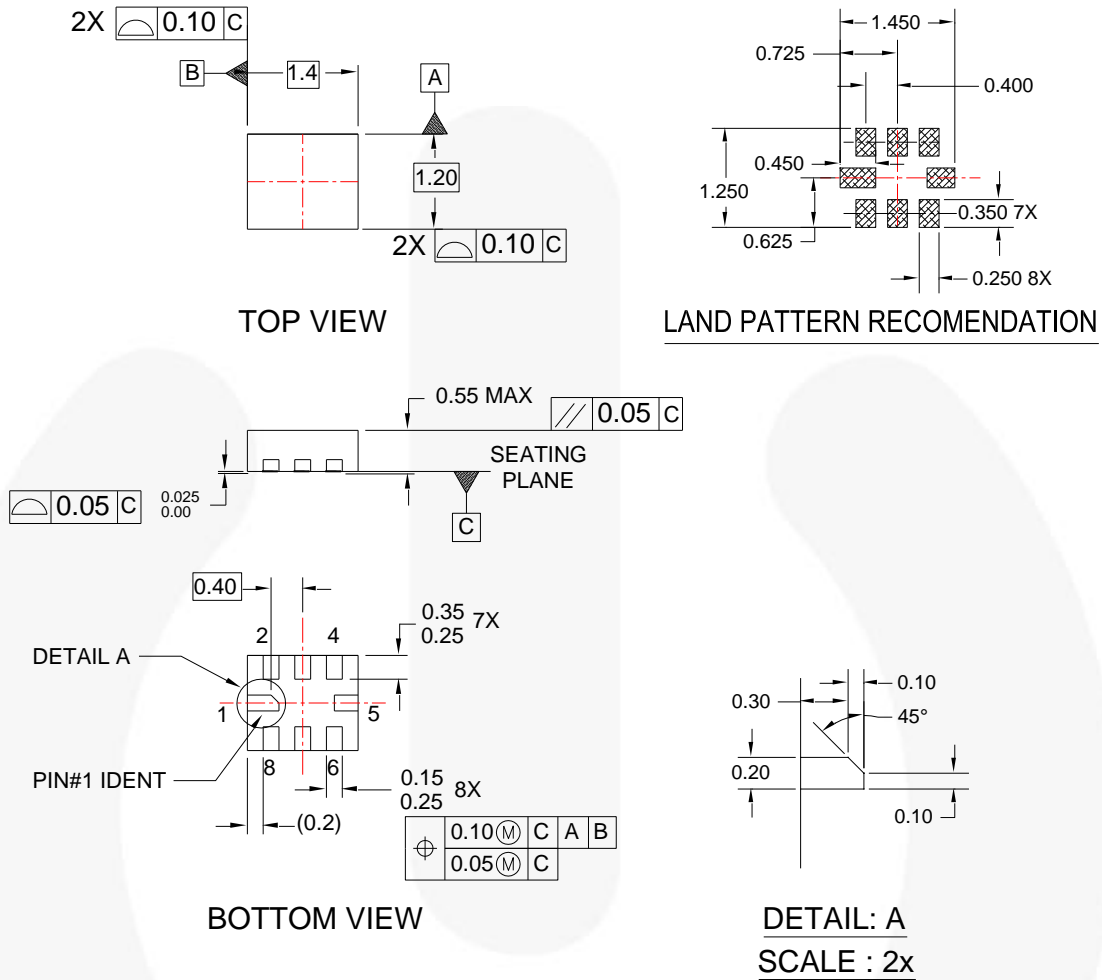
SCALE: 6X

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

10	30056	2.30 ± 0.1mm	1.78 ± 0.1mm	0.68 ± 0.1mm
8	30038	1.78 ± 0.1mm	1.78 ± 0.1mm	0.68 ± 0.1mm
6	30033	1.60 ± 0.1mm	1.15 ± 0.1mm	0.70 ± 0.1mm

Physical Dimensions



NOTES:

- A. DOES NOT CONFORMS TO JEDEC STANDARD.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES CONFORMS TO ASME Y14.5M, 1994.
- D. DRAWING FILE NAME : UMLP08Arev1

Figure 19. 8-Lead, Ultrathin Molded Leadless Package (UMLP), 1.2 x 1.4mm

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TinyWire™
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| FACT® | Motion-SPM™ | SuperSOT™.6 | |
| FAST® | OPTOLOGIC® | SuperSOT™.8 | |
| FAST® | OPTOPLANAR® | SupreMOS™ | |
| FastvCore™ |  ™ | SyncFET™ | |
| FETBench™ | PDP SPM™ | Sync-Lock™ | |

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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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