

# FSUSB30

## Low Power 2-Port Hi-Speed USB 2.0 (480Mbps) Switch

### General Description

The FSUSB30 is a Low Power, 2-Port Hi-Speed USB 2.0 switch. This part is configured as a DPDT switch and is optimized for switching between two Hi-Speed (480Mbps) sources or a Hi-Speed and Full Speed (12Mbps) source. The FSUSB30 is compatible with the requirements of USB2.0 and features an extremely low On Capacitance ( $C_{ON}$ ) of 6.5pF. The wide bandwidth of this device (720MHz), exceeds the bandwidth needed to pass the 3<sup>rd</sup> harmonic, resulting in signals with minimum edge and phase distortion. Superior channel-to-channel crosstalk also minimizes interference.

The FSUSB30 contains special circuitry on the D+/D- pins which allows the device to withstand an overvoltage condition. This device is also designed to minimize current consumption even when the control voltage applied to the 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 and connector sharing in portable cell phones, PDAs, digital cameras, printers, and notebook computers.

### Features

- Low On Capacitance, 6.5pF (typical)
- Low On Resistance, 6.5Ω (typical)
- Low power consumption (1μA maximum)
  - 10μA maximum  $I_{CCT}$  over and expanded control voltage range ( $V_{IN} = 2.6V$ ,  $V_{CC} = 4.3V$ )
- Wide -3dB bandwidth, >720MHz
- 8KV ESD protection
- Power OFF protection when  $V_{CC} = 0V$ , D+/D- pins can tolerate up to 4.3V
- Packaged in:
  - Pb-Free 10-lead MicroPak™ (1.6mm x 2.1mm)
  - Pb-Free 14-lead DQFN
  - Pb-Free 10-lead MSOP (preliminary)

### Applications

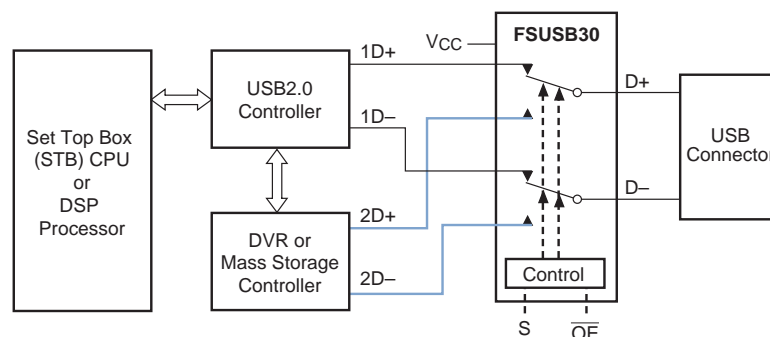
- Cell phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-top Box

### Ordering Information

Order Number	Package Number	Package Description
FSUSB30L10X	MAC010A	Pb-Free 10-Lead MicroPak, 1.6 mm x 2.1mm
FSUSB30BQX	MLP014A	Pb-Free 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm
FSUSB30MUX (Preliminary)	MUA10A	10-Lead Molded Small Outline Package (MSOP), JEDEC MO-187, 3.0mm Wide

Pb-Free package per JEDEC J-STD-020B.

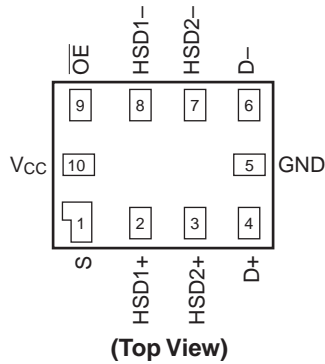
### Application Diagram



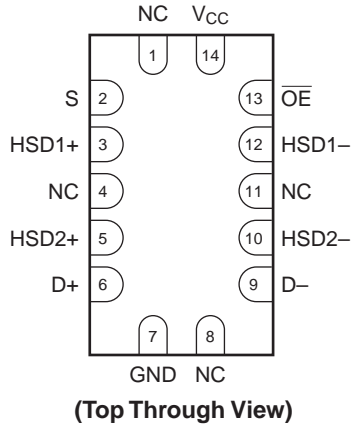
MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

## Connection Diagrams

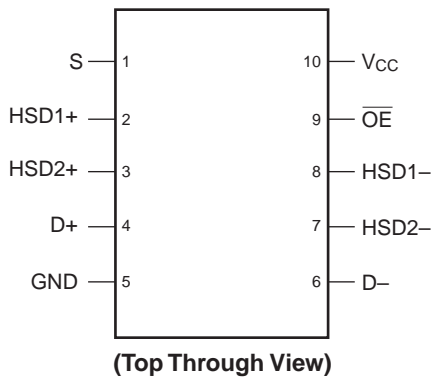
### Pad Assignments for MicroPak



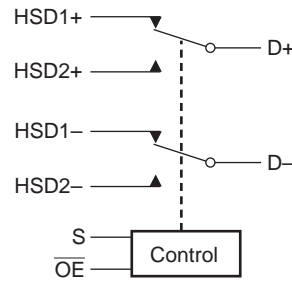
### Pad Assignments for DQFN



### Pin Assignment for MSOP



## Analog Symbol



## Pin Descriptions

Pin Name	Description
$\overline{OE}$	Bus Switch Enable
S	Select Input
D+, D-, HSDn+, HSDn-	Data Ports
NC	No Connect

## Truth Table

S	$\overline{OE}$	Function
X	H	Disconnect
L	L	D+, D- = HSD1 <sub>n</sub>
H	L	D+, D- = HSD2 <sub>n</sub>

## Absolute Maximum Ratings

(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.)

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	-0.5V to +4.6V
$V_{CNTRL}$	DC Input Voltage <sup>1</sup>	-0.5V to +4.6V
$V_{SW}$	DC Switch Voltage <sup>1</sup> HSDnX D+, D-	-0.5V to $V_{CC} + 0.3V$ -0.5V to +4.6V
	DC Input Diode Current	-50mA
	DC Output Current	50mA
	Storage Temperature	-65°C to +150°C
	ESD (Human Body Model) All Pins I/O to GND	8 KV 8 KV

## Recommended Operating Conditions<sup>2</sup>

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	3.0V to 4.3V
$V_{IN}$	Control Input Voltage	0V to $V_{CC}$
	Switch Input Voltage	0V to $V_{CC}$
	Operating Temperature	-40°C to +85°C
	Thermal Resistance, 10 MicroPak	250°C/W

### Notes:

1. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed. DC switch voltage may never exceed 4.6V.
2. Control input must be held HIGH or LOW and it must not float.

## DC Electrical Characteristics

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

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C			Units
				Min	Typ	Max	
V <sub>IK</sub>	Clamp Diode Voltage	I <sub>IN</sub> = -18mA	3.0			-1.2	V
V <sub>IH</sub>	Input Voltage HIGH		3.0 to 3.6	1.3			V
			4.3	1.7			V
V <sub>IL</sub>	Input Voltage LOW		3.0 to 3.6			0.5	V
			4.3			0.7	V
I <sub>IN</sub>	Control Input Leakage	V <sub>SW</sub> = 0.0V to V <sub>CC</sub>	4.3	-1.0		1.0	μA
I <sub>OZ</sub>	OFF State Leakage	0 ≤ D <sub>n</sub> , HSD1 <sub>n</sub> , HSD2 <sub>n</sub> ≤ V <sub>CC</sub>	4.3	-2.0		2.0	μA
I <sub>OFF</sub>	Power OFF Leakage Current (D+, D-)	V <sub>SW</sub> = 0V to 4.3V, V <sub>CC</sub> = 0V	0	-2.0		2.0	μA
R <sub>ON</sub>	Switch On Resistance <sup>3</sup>	V <sub>SW</sub> = 0.8V, I <sub>ON</sub> = -8mA	3.0		6.5	9.0	Ω
ΔR <sub>ON</sub>	Delta R <sub>ON</sub> <sup>4</sup>	V <sub>SW</sub> = 0.8V, I <sub>ON</sub> = -8mA	3.0		0.35		Ω
R <sub>ON Flatness</sub>	R <sub>ON Flatness</sub> <sup>3</sup>	V <sub>SW</sub> = 0.0V - 1.0V, I <sub>ON</sub> = -8mA	3.0		2.0		Ω
I <sub>CC</sub>	Quiescent Supply Current	V <sub>CNTRL</sub> = 0.0V or V <sub>CC</sub> , I <sub>OUT</sub> = 0	4.3			1.0	μA
I <sub>CC T</sub>	Increase in I <sub>CC</sub> Current per Control Voltage	V <sub>CNTRL</sub> (control input) = 2.6V	4.3			10.0	μA

## AC Electrical Characteristics

(All typical values are for V<sub>CC</sub> = 3.3V @ 25°C unless otherwise specified.)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C			Units	Figure Number
				Min	Typ	Max		
t <sub>ON</sub>	Turn On Time S, OE to Output	HD1 <sub>n</sub> , HD2 <sub>n</sub> = 0.8V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF	3.0 to 3.6		13.0	30.0	ns	Figure 8
t <sub>OFF</sub>	Turn OFF Time S, OE to Output	HD1 <sub>n</sub> , HD2 <sub>n</sub> = 0.8V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF	3.0 to 3.6		12.0	25.0	ns	Figure 8
t <sub>PD</sub>	Propagation Delay <sup>4</sup>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF	3.3		0.25		ns	Figure 6 Figure 7
T <sub>BBM</sub>	Break-Before-Make	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, V <sub>IN</sub> = 0.8V	3.0 to 3.6	2.0		6.5	ns	Figure 9
O <sub>IRR</sub>	OFF Isolation (Non-Adjacent)	f = 240MHz, R <sub>T</sub> = 50Ω	3.0 to 3.6		-30.0		dB	Figure 12
Xtalk	Non-Adjacent Channel Crosstalk	R <sub>T</sub> = 50Ω, f = 240MHz	3.0 to 3.6		-45.0		dB	Figure 13
BW	-3dB Bandwidth	R <sub>T</sub> = 50Ω, C <sub>L</sub> = 0pF	3.0 to 3.6		720		MHz	Figure 11
		R <sub>T</sub> = 50Ω, C <sub>L</sub> = 5pF			550			

### Notes:

3. Measured by the voltage drop between D<sub>n</sub>, HSD1<sub>n</sub>, HSD2<sub>n</sub> pins at the indicated current through the switch. On Resistance is determined by the lower of the voltage on the two ports.
4. Guaranteed by characterization.

## USB Hi-Speed Related AC Electrical Characteristics

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C			Units	Figure Number
				Min	Typ	Max		
t <sub>SK(O)</sub>	Channel-to-Channel Skew <sup>5</sup>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF	3.0 to 3.6		50.0		ps	Figure 6 Figure 10
t <sub>SK(P)</sub>	Skew of Opposite Transitions of the Same Output <sup>5</sup>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF	3.0 to 3.6		20.0		ps	Figure 6 Figure 10
t <sub>J</sub>	Total Jitter <sup>5</sup>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, t <sub>R</sub> = t <sub>F</sub> = 500ps at 480 Mbps (PRBS = 2 <sup>15</sup> - 1)	3.0 to 3.6		200		ps	

### Notes:

5. Guaranteed by characterization.

## Capacitance

Symbol	Parameter	Conditions	T <sub>A</sub> = -40°C to +85°C			Units	Figure Number
			Min	Typ	Max		
C <sub>IN</sub>	Control Pin Input Capacitance	V <sub>CC</sub> = 0V		1.5		pF	Figure 15
C <sub>ON</sub>	D1 <sub>n</sub> , D2 <sub>n</sub> , Dn ON Capacitance	V <sub>CC</sub> = 3.3, $\overline{OE}$ = 0V		6.5		pF	Figure 14
C <sub>OFF</sub>	D1 <sub>n</sub> , D2 <sub>n</sub> OFF Capacitance	V <sub>CC</sub> and $\overline{OE}$ = 3.3		2.5		pF	Figure 15

Typical Characteristics

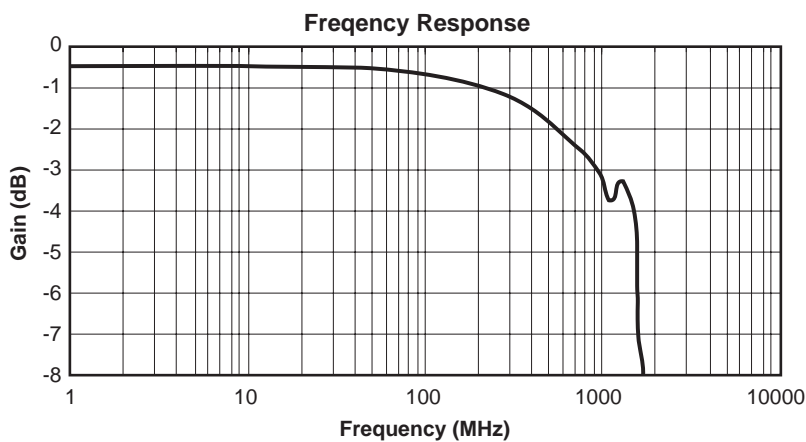


Figure 1. Gain vs. Frequency,  $C_L = 0pF$ ,  $V_{CC} = 3.3V$

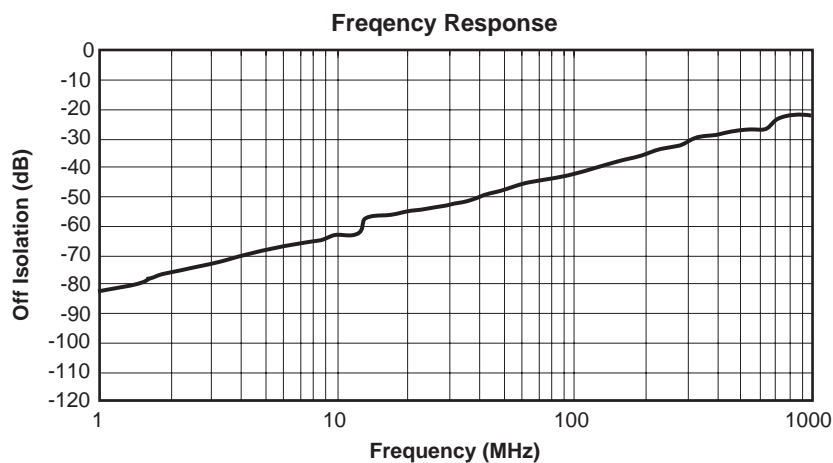


Figure 2. OFF Isolation,  $V_{CC} = 3.3V$

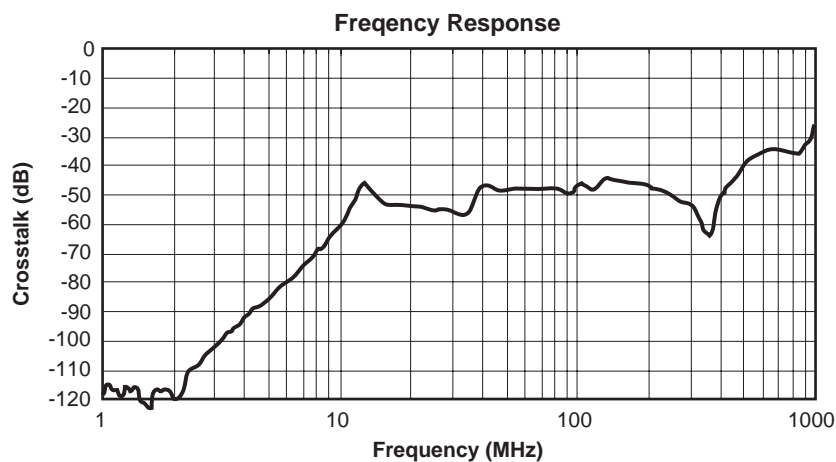
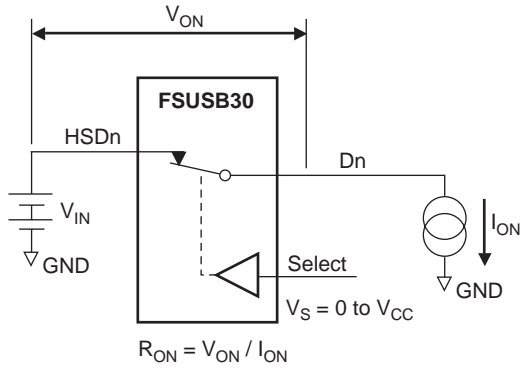
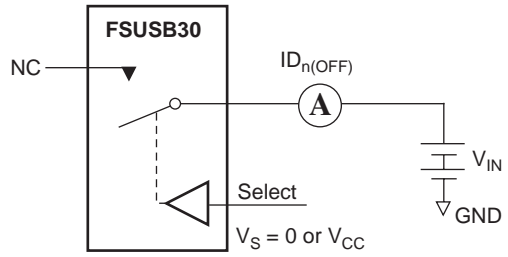


Figure 3. Crosstalk,  $V_{CC} = 3.3V$

### Test Diagrams

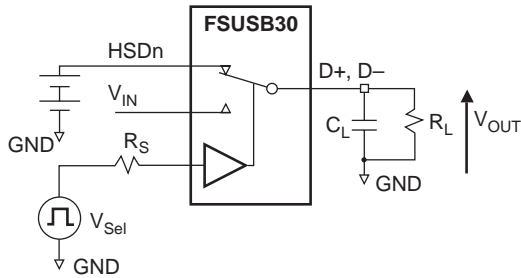


**Figure 4. On Resistance**



Each switch port is tested separately.

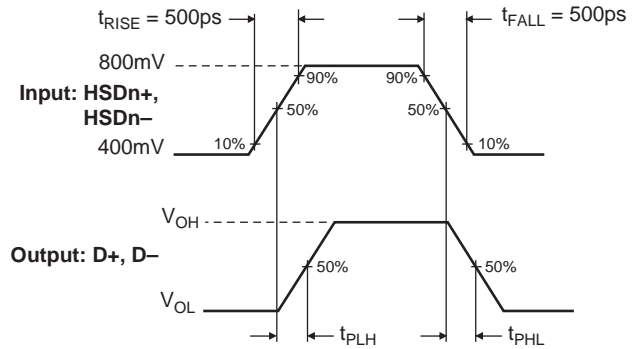
**Figure 5. OFF Leakage**



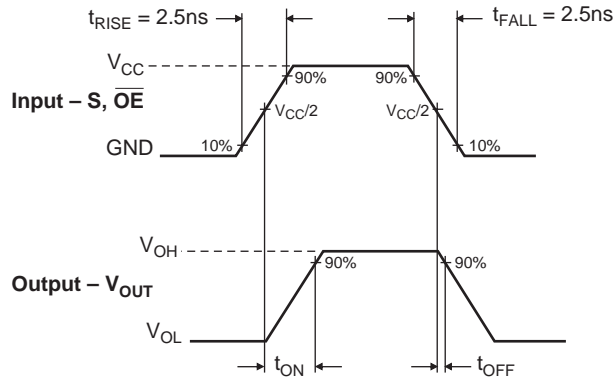
$R_L$ ,  $R_S$ , and  $C_L$  are functions of the application environment (see AC Electrical tables for specific values).

$C_L$  includes test fixture and stray capacitance.

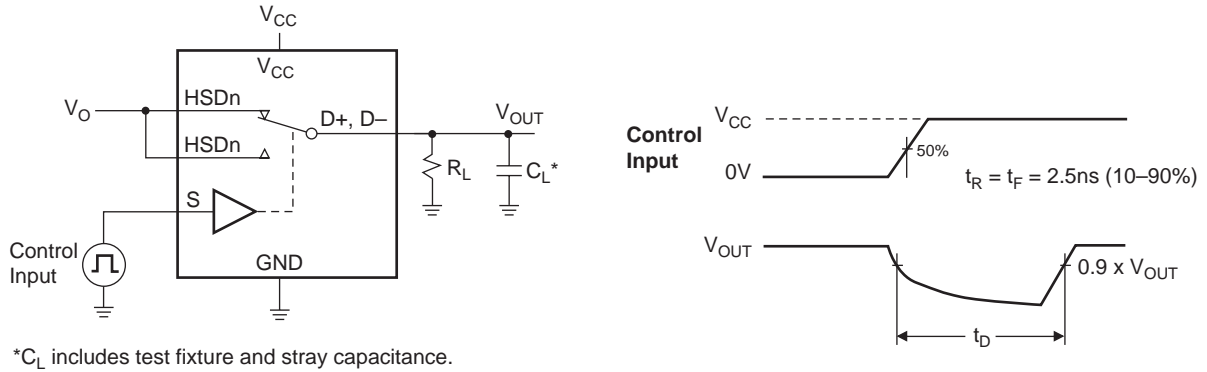
**Figure 6. AC Test Circuit Load**



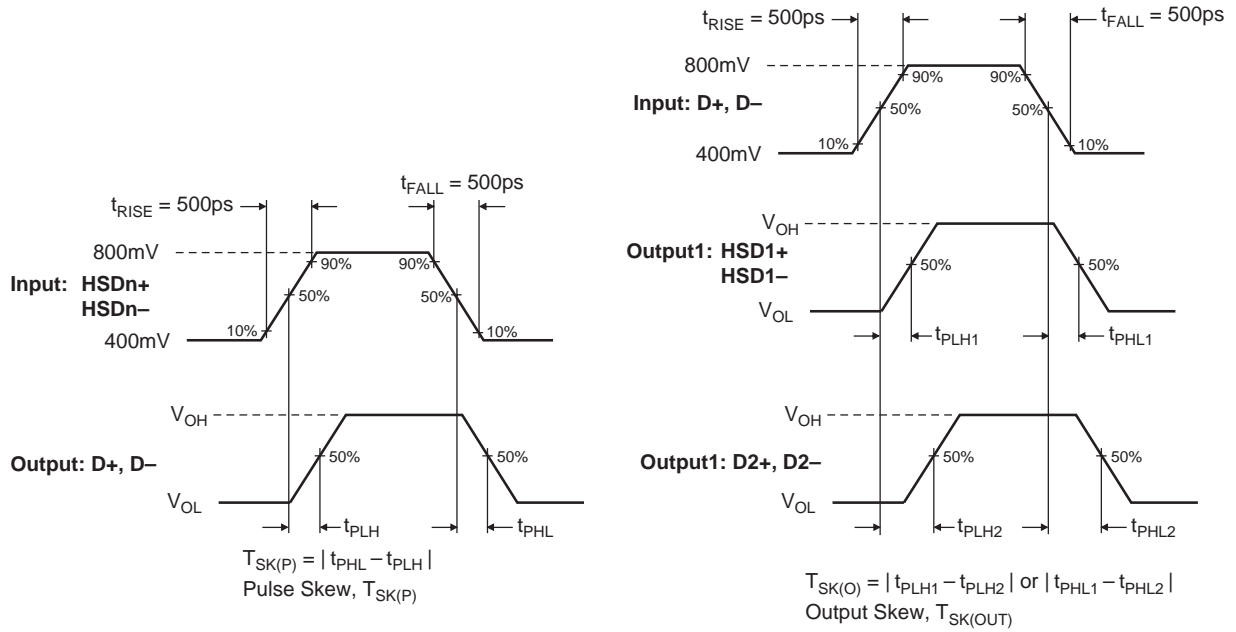
**Figure 7. Switch Propagation Delay Waveforms**



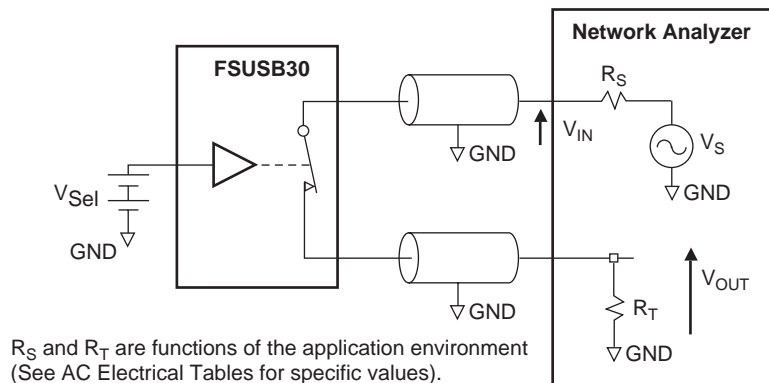
**Figure 8. Turn ON / Turn OFF Waveform**



**Figure 9. Break-before-Make (T<sub>BBM</sub>)**

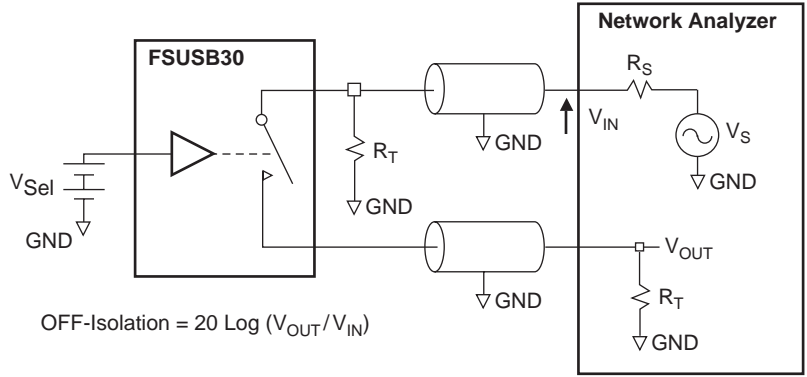


**Figure 10. Switch Skew Tests**

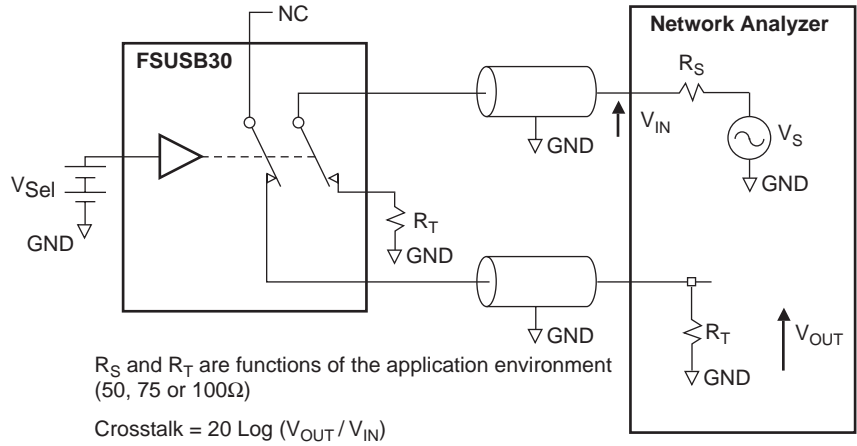


**Figure 11. Bandwidth**

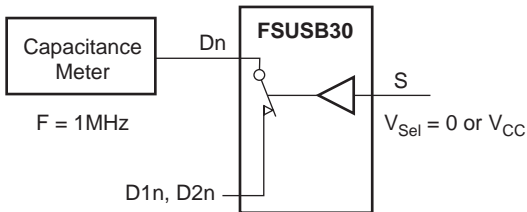




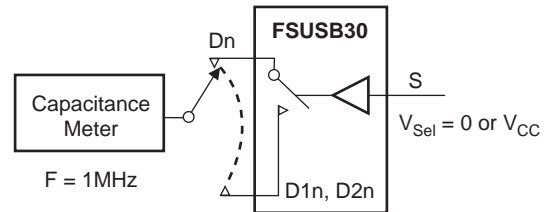
**Figure 12. Channel OFF Isolation**



**Figure 13. Non-Adjacent Channel-to-Channel Crosstalk**



**Figure 14. Channel ON Capacitance**



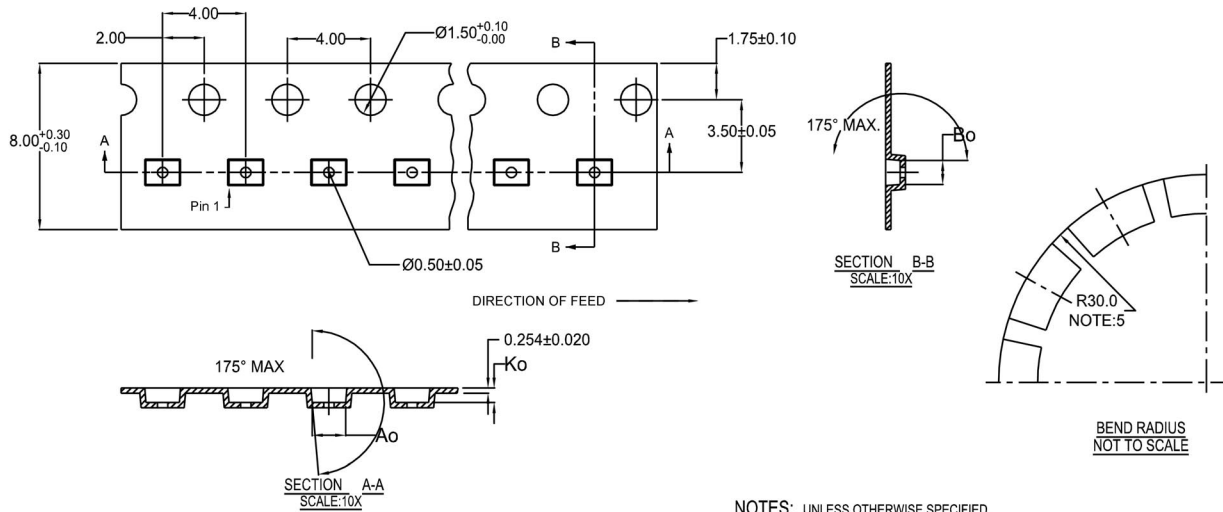
**Figure 15. Channel OFF Capacitance**

## Tape and Reel Specifications

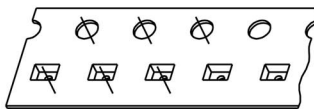
### Tape Format for MircoPak

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

### Tape Dimension inches (millimeters)



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

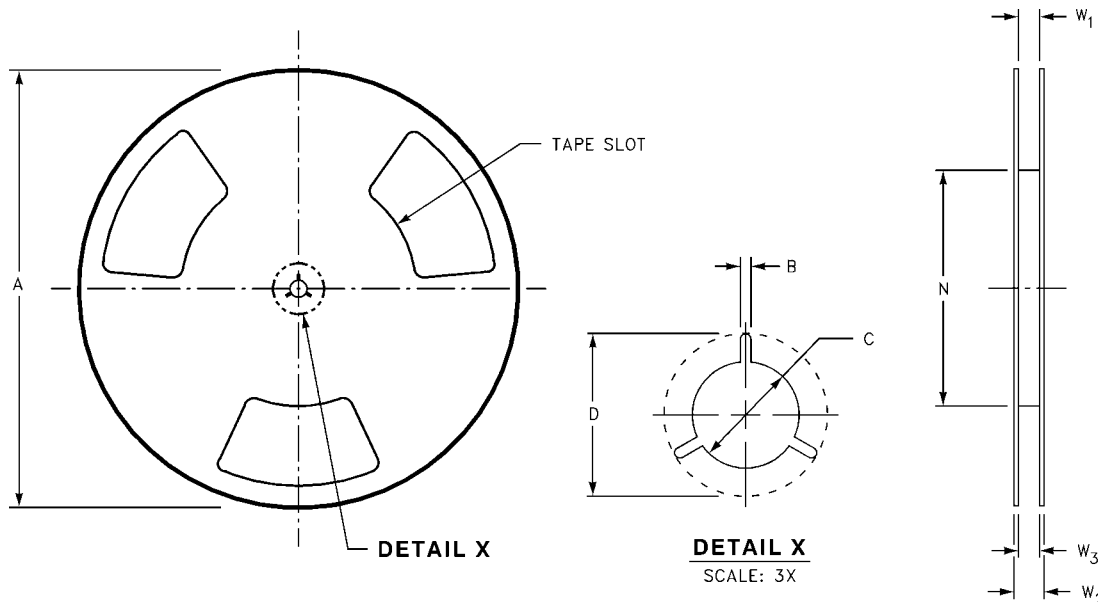


SCALE: 6X

#### 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

Reel Dimension for MircoPak inches (millimeters)

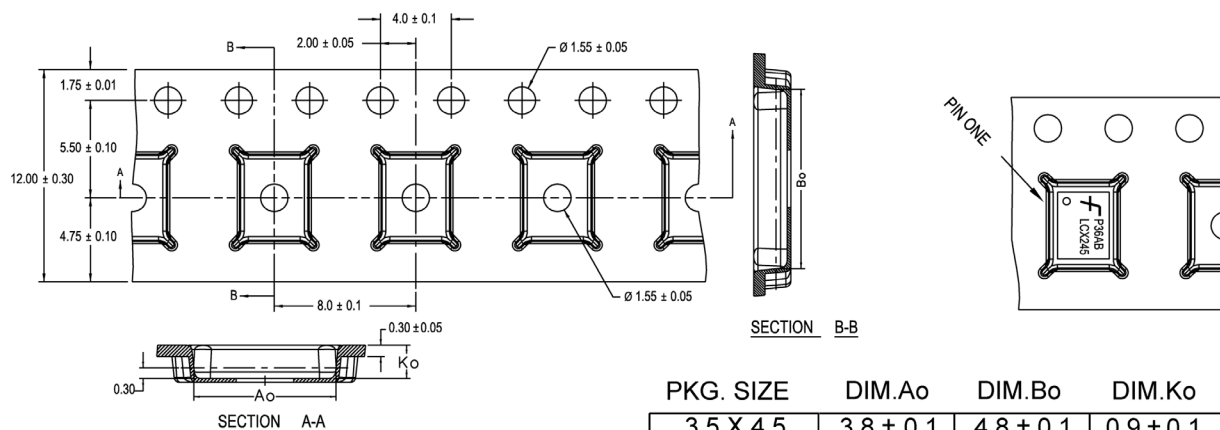


Tape Size	A	B	C	D	N	W1	W2	W3
8 mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 + 0.059/-0.000 (8.40 + 1.50/-0.00)	0.567 (14.40)	W1 + 0.078/-0.039 (W1 + 2.00/-1.00)

### Tape Format for DQFN

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
BQX	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	2500/3000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

### Tap Dimensions inches (millimeters)



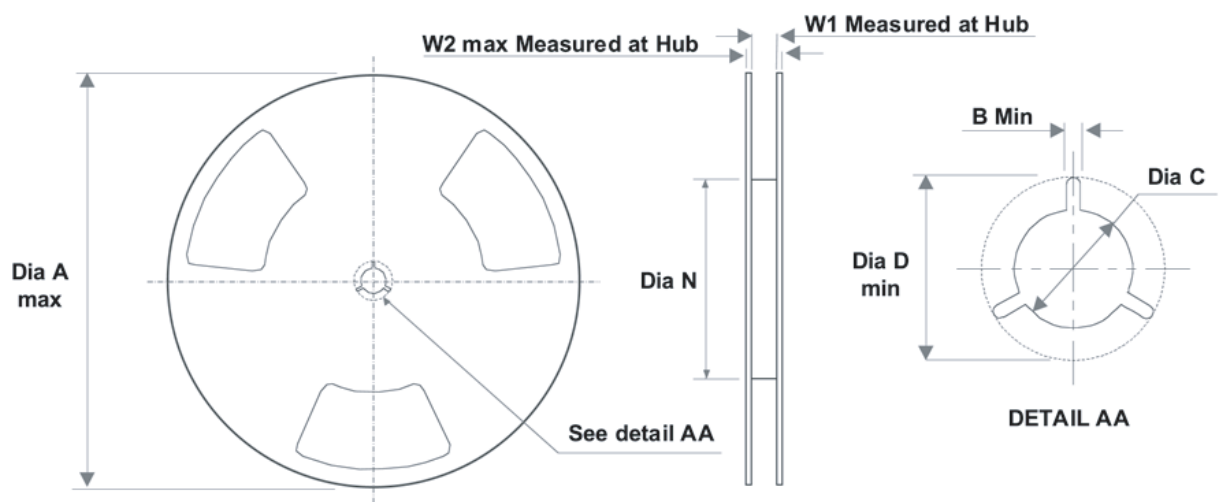
PKG. SIZE	DIM.Ao	DIM.Bo	DIM.Ko
3.5 X 4.5	3.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
3.0 X 3.0	3.3 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 4.5	2.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
2.5 X 3.5	2.8 ± 0.1	3.8 ± 0.1	0.9 ± 0.1
2.5 X 3.0	2.8 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 2.5	2.8 ± 0.1	2.8 ± 0.1	0.9 ± 0.1

DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

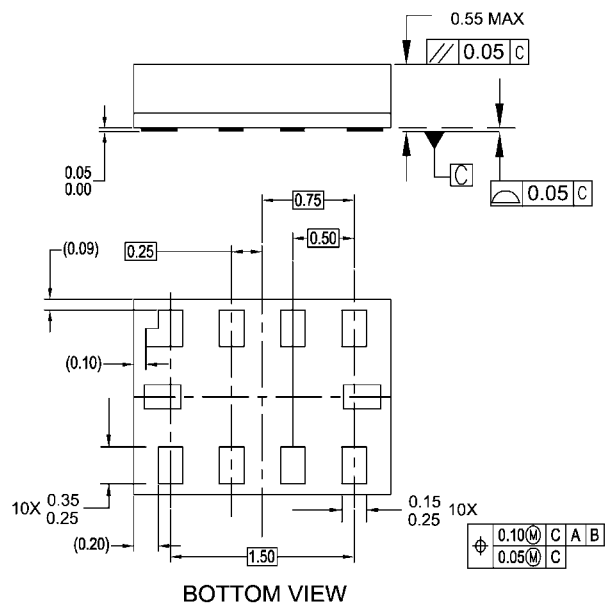
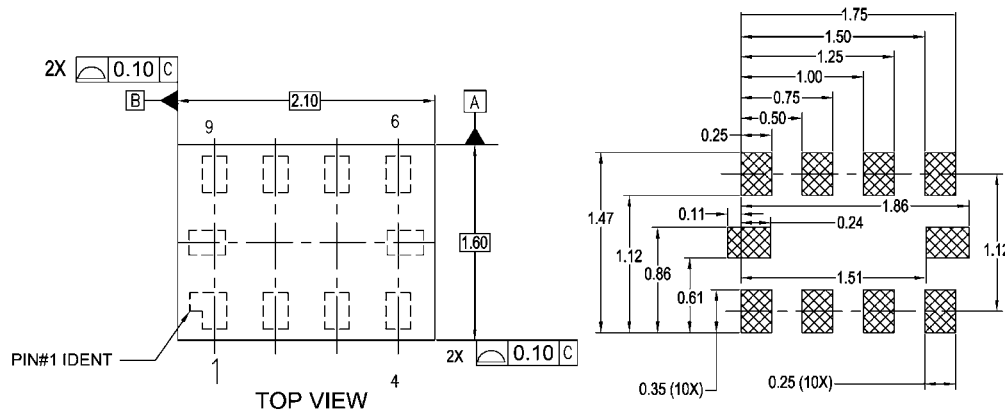
1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is ±0.002[0.05] for these dimensions on all 12mm tapes.
5. Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
6. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

Reel Dimensions for DQFN inches (millimeters)



Tape Size	A	B	C	D	N	W1	W2
12 mm	13.0 (330)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	7.008 (178)	0.488 (12.4)	0.724 (18.4)

**Physical Dimensions** inches (millimeters) unless otherwise noted

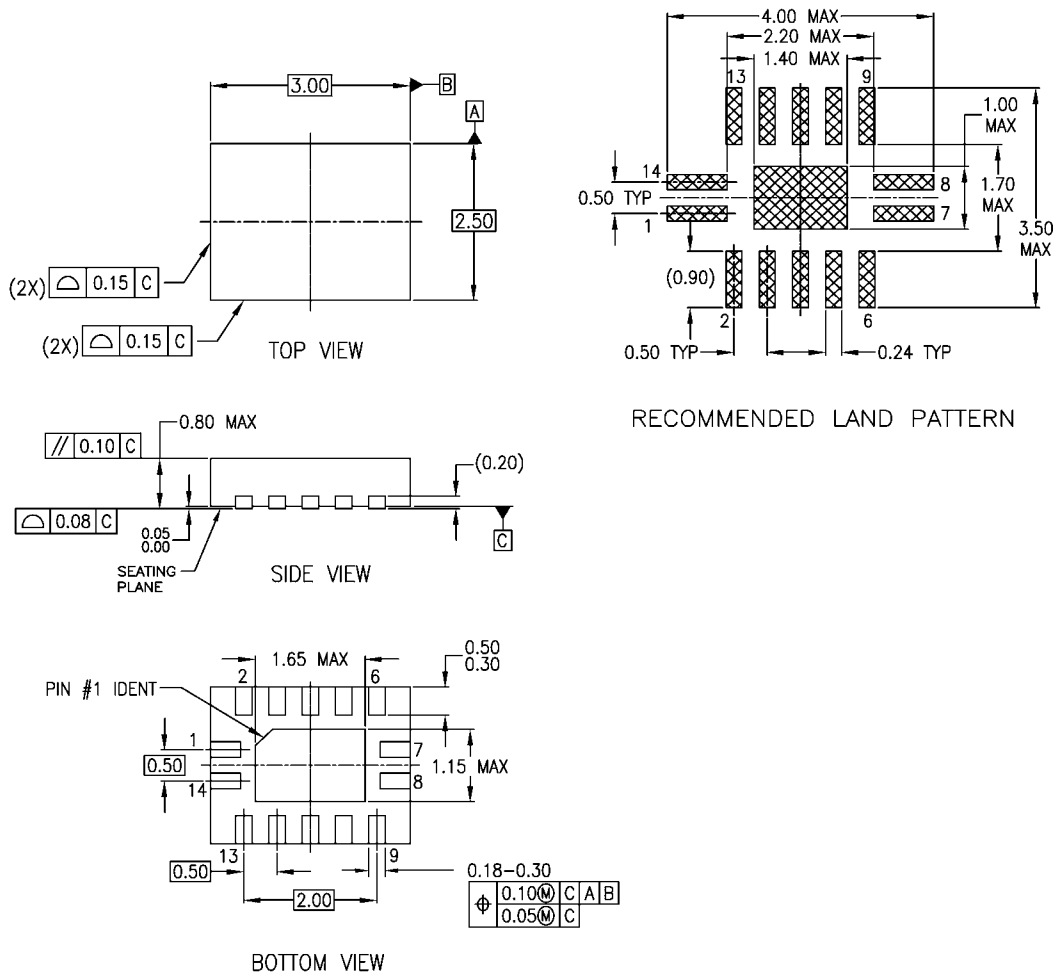


**NOTES:**

- A. PACKAGE CONFORMS TO JEDEC MO255, VARIATION UABD
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES CONFORMS TO ASME Y14.5M, 1994.

MAC010ARevC

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

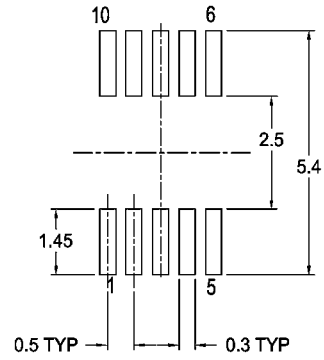
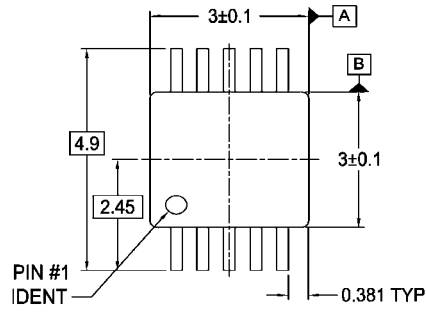


**NOTES:**

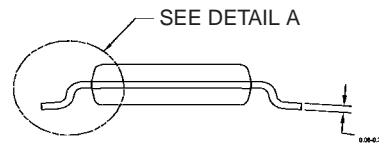
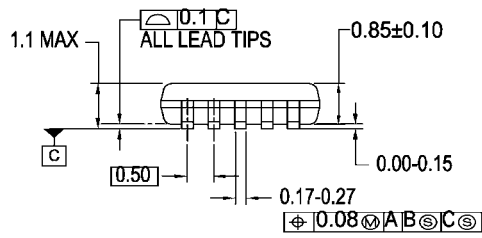
- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AA
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP014ArevA

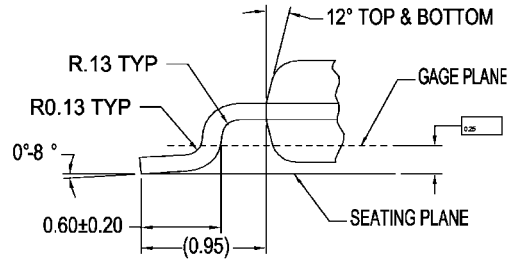
**Pb-Free 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm Package Number MLP014A**



LAND PATTERN RECOMENDATION



DIMENSIONS ARE IN MILLIMETERS



DETAIL A

**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

**10-Lead Molded Small Outline Package (MSOP), JEDEC MO-187, 3.0mm Wide  
Package Number MUA10A**



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ActiveArray™	FASTr™	LittleFET™	PowerTrench®	SuperSOT™-8
Bottomless™	FPS™	MICROCOUPLER™	QFET®	SyncFET™
Build it Now™	FRFET™	MicroFET™	QS™	TCM™
CoolFET™	GlobalOptoisolator™	MicroPak™	QT Optoelectronics™	TinyLogic®
CROSSVOLT™	GTO™	MICROWIRE™	Quiet Series™	TINYOPTO™
DOME™	HiSeC™	MSX™	RapidConfigure™	TruTranslation™
EcoSPARK™	I <sup>2</sup> C™	MSXPro™	RapidConnect™	UHC™
E <sup>2</sup> CMOS™	i-Lo™	OCX™	μSerDes™	UltraFET®
EnSigna™	ImpliedDisconnect™	OCXPro™	ScalarPump™	UniFET™
FACT™	IntelliMAX™	OPTOLOGIC®	SILENT SWITCHER®	VCX™
FACT Quiet Series™		OPTOPLANAR™	SMART START™	Wire™
		PACMAN™	SPM™	
Across the board. Around the world.™		POP™	Stealth™	
The Power Franchise®		Power247™	SuperFET™	
Programmable Active Droop™		PowerEdge™	SuperSOT™-3	

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2. A critical component is 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.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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