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## FSUSB20 — Low-Power, 1-Port, High-Speed USB (480Mbps) Switch

### Features

- -30dB Off Isolation: 250MHz
- -30dB Non-adjacent Channel Crosstalk: 250MHz
- On Resistance: 4.5Ω Typical (R<sub>ON</sub>)
- -3dB Bandwidth: >720MHz
- Low-Power Consumption: 1μA Maximum
- Control Input: LVTTTL Compatible
- Bi-Directional Operation
- USB High-Speed and Full-Speed Signaling Capability

### Applications

- Cell Phones, PDAs, Digital Cameras, Notebook Computers

### Description

FSUSB20 is a low-power, high-bandwidth switch specially designed for switching high-speed USB 2.0 signals in handset and consumer applications; such as cell phone, digital camera, and notebook with hubs or controllers of limited USB I/O. The wide bandwidth (>720MHz) allows signals to pass with minimum edge and phase distortion. Superior channel-to-channel crosstalk results in minimal interference. It is compatible with the high-speed USB 2.0 standard.

### Ordering Information

Part Number	Operating Temperature Range	Package	Packing Method
FSUSB20L10X	-40 to +85°C	10-Lead MicroPak™, 1.6 x 2.1mm	Tape and Reel
FSUSB20BQX	-40 to +85°C	14-Terminal Depopulation Quad Very-Thin Flat Pack No Lead (DQFN), JEDEC MO-241, 2.5 X 3.0mm	Tube
FSUSB20MUX	-40 to +85°C	10-Lead Molded Small Outline Package (MSOP), JEDEC MO-187, 3.0mm Wide	Tape and Reel

## Connection Diagrams

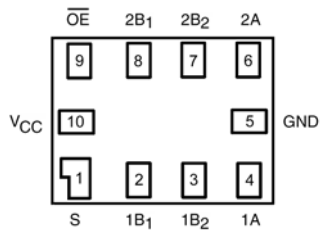


Figure 1. MicroPak™ (Top View)

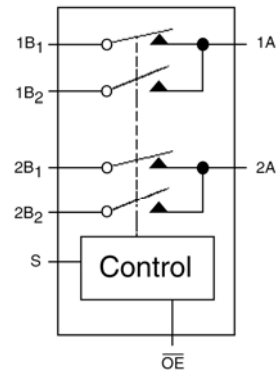


Figure 2. Analog Symbol

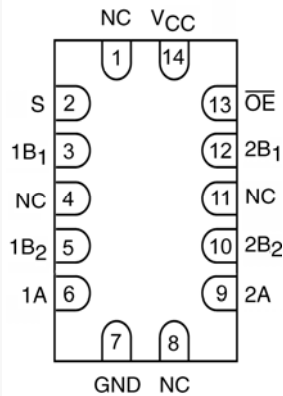


Figure 3. DQFN (Top Through View)

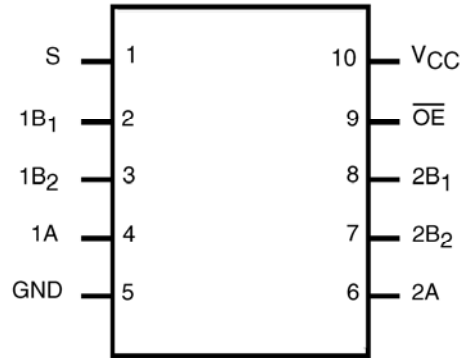


Figure 4. MSOP (Top Through View)

## Pin Descriptions

Pin # MicroPak™ / MSOP	Pin # DQFN	Pin Names	Description
1	2	S	Select Input
2, 3, 7, 8	3, 5, 10, 12	1B <sub>1</sub> , 1B <sub>2</sub> , 2B <sub>2</sub> , 2B <sub>1</sub>	Bus B
5	7	GND	Ground
4, 6	6, 9	1A, 2A	Bus A
9	12	OE	Bus Switch Enable
10	14	V <sub>CC</sub>	Supply Voltage

## Truth Table

S	OE	Function
Don't Care	HIGH	Disconnect
LOW	LOW	A=B <sub>1</sub>
HIGH	LOW	A=B <sub>2</sub>

## 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	4.6	V
$V_S$	DC Switch Voltage	-0.5	$V_{CC} + 0.05$	V
$V_{IN}$	DC Input Voltage <sup>(1)</sup>	-0.5	4.6	V
$I_{IK}$	DC Input Diode Current, $V_{IN} < 0V$	-50		mA
$I_{OUT}$	DC Output Sink Current	50		mA
$I_{CC} / I_{GND}$	DC $V_{CC}$ / GND Current	$\pm 100$		mA
$T_{STG}$	Storage Temperature Range	-65	+150	°C
ESD	Human Body Model, JESD22-A114	All Pins	7000	V
		I/O to GND	7000	

**Note:**

- The input and output negative voltage 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	
$V_{CC}$	Power Supply Operating	3.0	3.6	V	
$V_{IN}$	Input Voltage	0	$V_{CC}$	V	
$V_{OUT}$	Output Voltage	0	$V_{CC}$	V	
$t_r, t_f$	Input Rise and Fall Time	Switch Control Input <sup>(2)</sup>	0	5	ns/V
		Switch I/O	0	DC	
$T_A$	Operating Temperature, Free Air	-40	+85	°C	

**Note:**

- Unused control inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

Typical values are at  $V_{CC} = 3.0V$  and  $T_A = 25^\circ C$ .

Symbol	Parameter	Condition	$V_{CC}$ (V)	$T_A = -40$ to $+85^\circ C$			Unit
				Min.	Typ.	Max.	
$V_{IK}$	Clamp Diode Voltage	$I_{IN} = -18mA$	3.0			-1.2	V
$V_{IH}$	High-Level Input Voltage		3.0 to 3.6	2.0			V
$V_{IL}$	Low-Level Input Voltage		3.0 to 3.6			0.8	V
$I_{IN}$	Input Leakage Current	$0 \leq V_{IN} \leq 3.6V$	3.6			$\pm 1.0$	$\mu A$
$I_{OFF}$	Off-State Leakage Current	$0 \leq A, B \leq V_{CC}$	3.6			$\pm 1.0$	$\mu A$
$R_{ON}$	Switch On Resistance <sup>(3)</sup>	$V_{IN} = 0.8V, I_{ON} = 8mA$	3.0		5	7	$\Omega$
		$V_{IN} = 3.0V, I_{ON} = 8mA$	3.0		4.5	6.5	
$\Delta R_{ON}$	Delta $R_{ON}$	$V_{IN} = 0.8V, V_{IN} = 0V - 1.5V,$ $I_{ON} = 8mA$	3.0		0.3		$\Omega$
$R_{FLAT(ON)}$	On Resistance Flatness <sup>(4)</sup>	$I_{OUT} = 8mA$	3.0		1		$\Omega$
$I_{CC}$	Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND, $I_{OUT} = 0$	3.6			1	$\mu A$

### Notes:

3. Measured by the voltage drop between the A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltages on the A or B pins.
4. Flatness is defines as the difference between the maximum and the minimum value on resistance over the specified range of conditions.

## AC Electrical Characteristics

Typical values are at  $V_{CC} = 3.3V$  and  $T_A = 25^\circ C$ .

Symbol	Parameter	Condition	$V_{CC}(V)$	Typ.	Max.	Unit	Figure
$t_{ON}$	Turn-On Time S-to-Bus B	$V_B = 0.8V$	3.0 to 3.6	4.8	7.0	ns	Figure 9 Figure 10
$t_{OFF}$	Turn-Off Time S-to-Bus B	$V_B = 0.8V$	3.0 to 3.6	2.2	4.0	ns	Figure 9 Figure 10
$t_{PD}$	Propagation Delay	$C_L = 10pF$	3.0 to 3.6	0.25		ns	Figure 14
$O_{IRR}$	Non-Adjacent Off Isolation	$f = 250MHz,$ $R_L = 50\Omega$	3.0 to 3.6	-26		dB	Figure 11
$X_{TALK}$	Non-Adjacent Channel Crosstalk	$f = 250MHz,$ $R_L = 50\Omega$	3.0 to 3.6	-45		dB	Figure 12
BW	-3dB Bandwidth	$R_L = 50\Omega, C_L = 0pF$	3.0 to 3.6	750		MHz	Figure 13
		$R_L = 50\Omega, C_L = 5pF$		435			

## USB Related AC Electrical Characteristics

Typical values are at  $V_{CC} = 3.3V$  and  $T_A = 25^\circ C$ .

Symbol	Parameter	Condition	$V_{CC} (V)$	Typ.	Unit	Figure
$t_{SK(O)}$	Channel-to Channel Skew	$C_L = 10pF$	3.0 to 3.6	0.051	ns	Figure 14 Figure 16
$t_{SK(P)}$	Skew of Opposite Transition of the Same Output	$C_L = 10pF$	3.0 to 3.6	0.020	ns	Figure 14 Figure 16
$T_J$	Total Jitter	$R_L = 50\Omega, C_L = 10pF$ $t_R = t_F = 750ps$ at 480MPs	3.0 to 3.6	0.170	ns	

## Capacitance

Typical values are at  $V_{CC} = 3.3V$  and  $T_A = 25^\circ C$ .

Symbol	Parameter	Condition	Typ.	Unit
$C_{IN}$	Control Pin Input Capacitance	$V_{CC} = 0V$	2.5	pF
$C_{ON}$	A/B On Capacitance	$V_{CC} = 3.3V, /OE = 0V$	12.0	pF
$C_{OFF}$	Port B Off Capacitance	$V_{CC}$ and $/OE = 3.3V$	4.5	pF

## Performance Characteristics

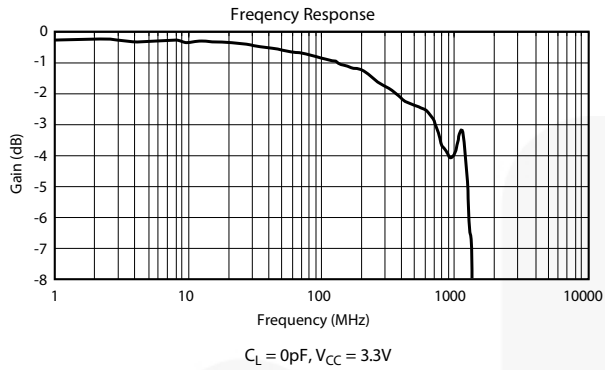


Figure 5. Gain vs. Frequency

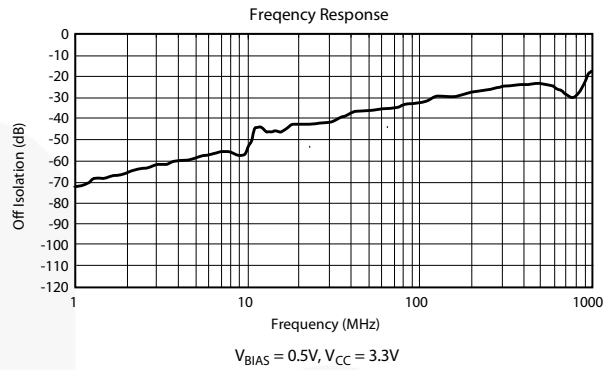


Figure 6. Off Isolation

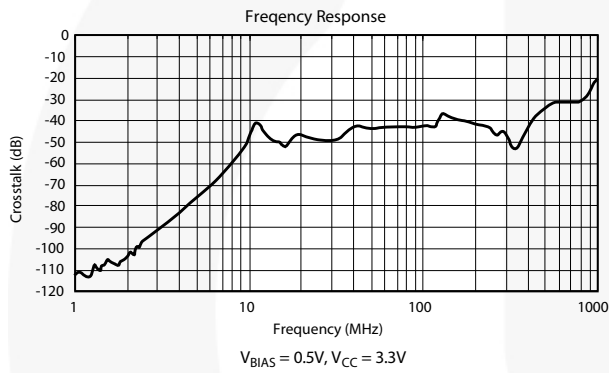


Figure 7. Crosstalk

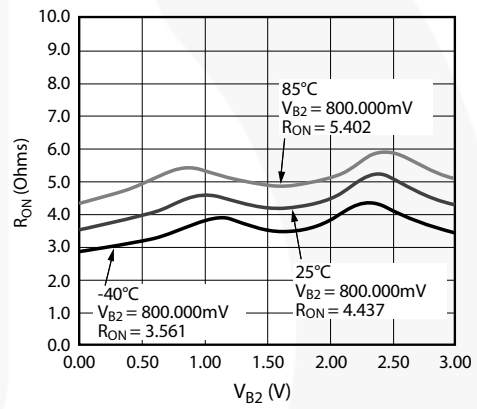
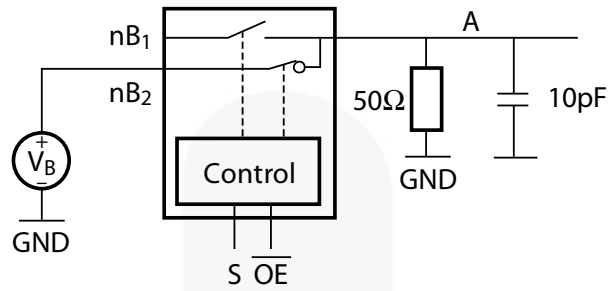


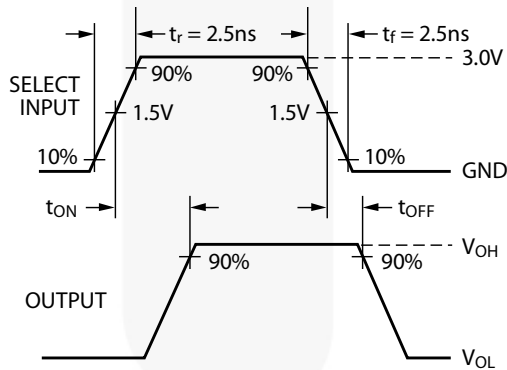
Figure 8.  $R_{ON}$

## AC Loadings and Waveforms

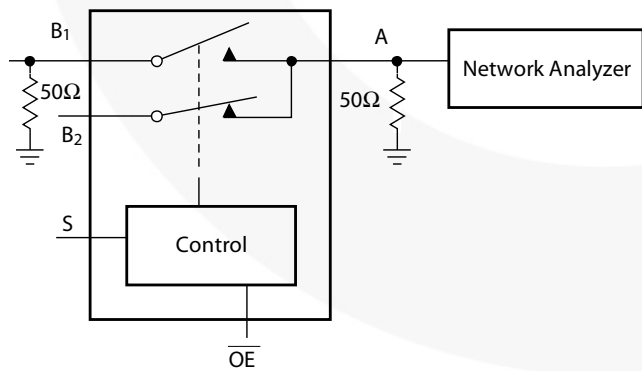


Notes: Input driven by 50Ω source terminated in 50Ω.  
 $C_L$  includes load and stray capacitance.  
 Input PRR-1.0MHz,  $t_w = 500\text{ns}$ .

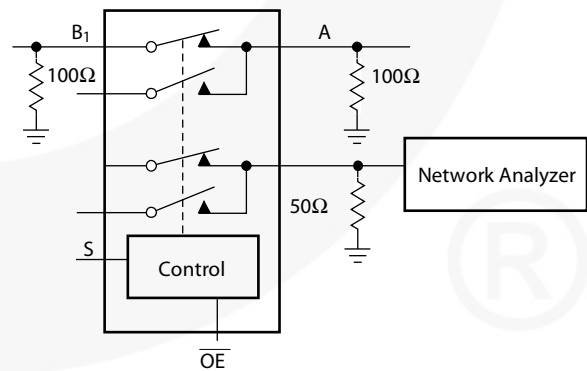
**Figure 9. AC Test Circuit**



**Figure 10. AC Waveforms**



**Figure 11. Off Isolation Test**



**Figure 12. Crosstalk Test**



AC Loadings and Waveforms

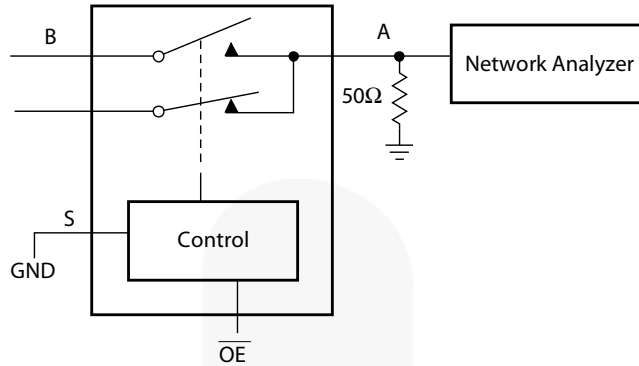


Figure 13. Bandwidth Test

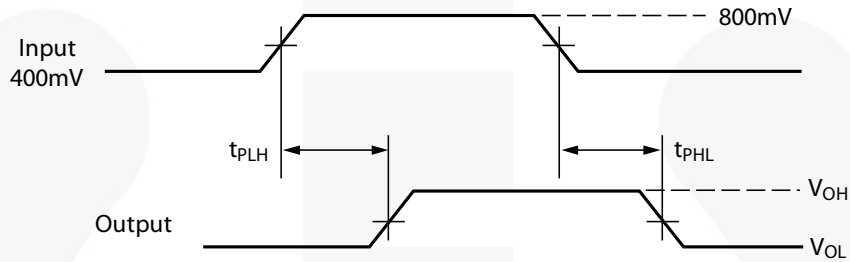


Figure 14. Propagation Delay

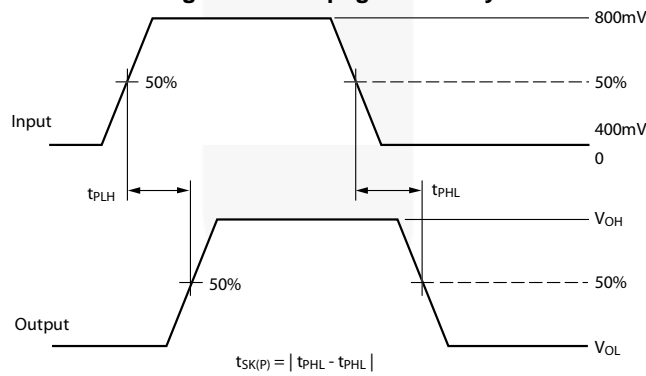


Figure 15. Pulse Skew  $t_{SP(P)}$

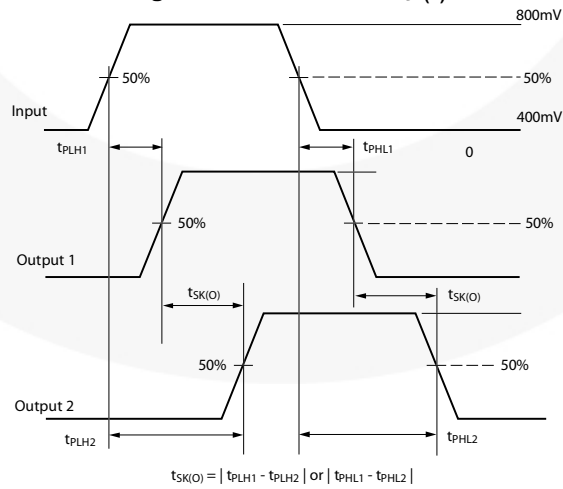
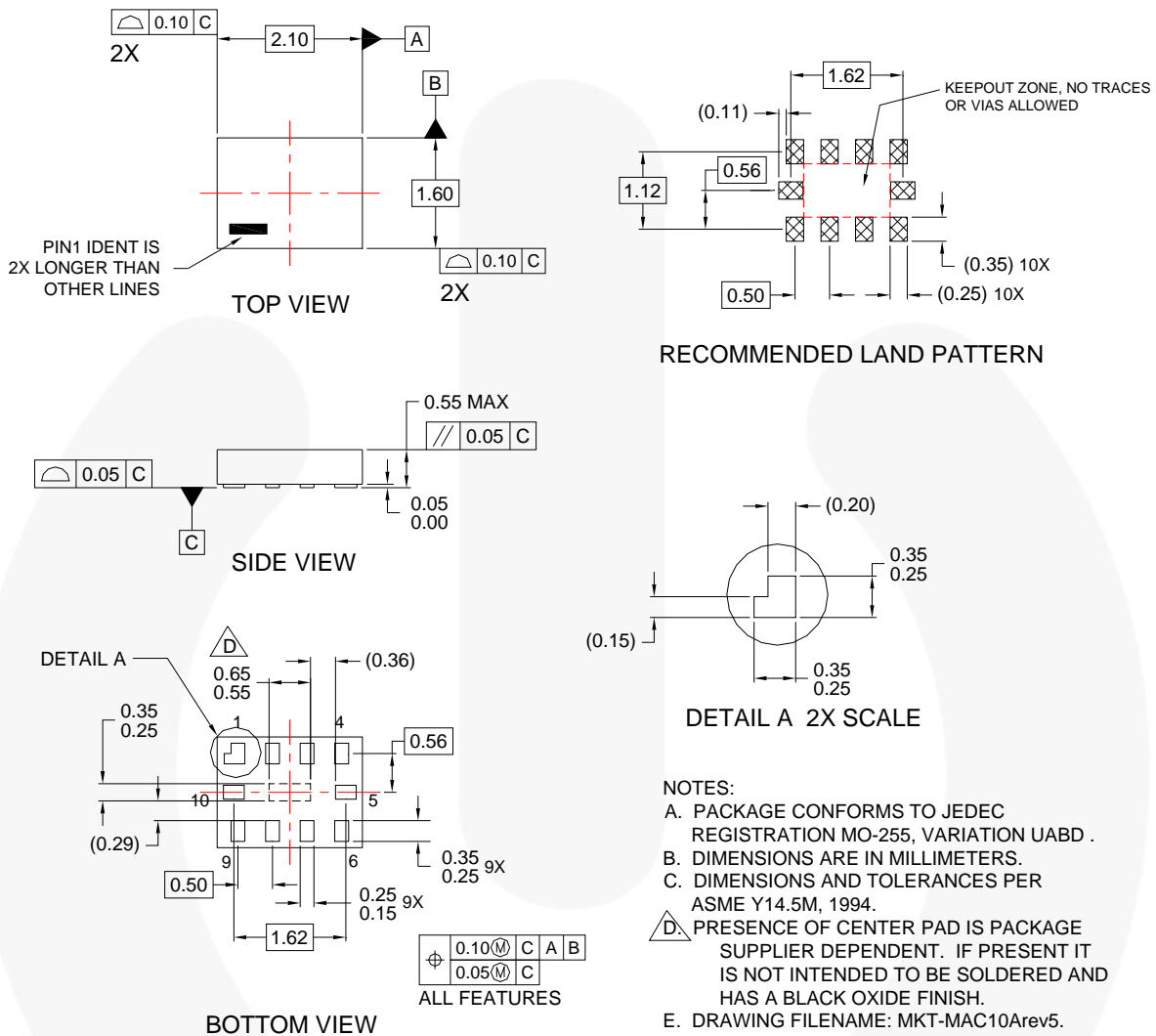


Figure 16. Output Skew  $t_{SK(O)}$

## Physical Dimensions



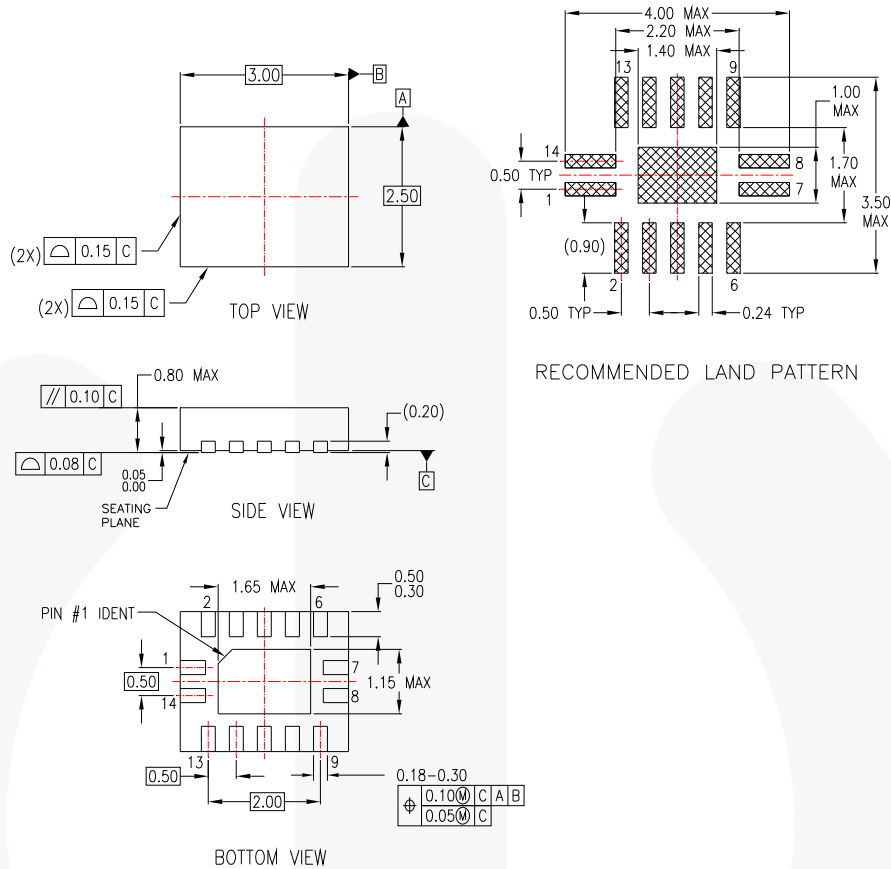
**Figure 17. 10-Lead MicroPak™, 1.6 x 2.1mm**

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## Physical Dimensions



### NOTES:

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

MLP14ArevA

**Figure 18. 14-Terminal Depopulation Quad Very-Thin Flat Pack No Lead (DQFN), JEDEC MO-241, 2.5 X 3.0mm**

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