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FAIRCHILD

SEMICONDUCTOR®

April 2012

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_{ON})
- -3dB Bandwidth: >720MHz
- Low-Power Consumption: 1µA Maximum
- Control Input: LVTTL 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.

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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
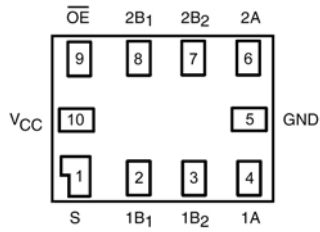
Figure 1. MicroPak™ (Top View)

Figure 2. Analog Symbol

Figure 3. DQFN (Top Through View)
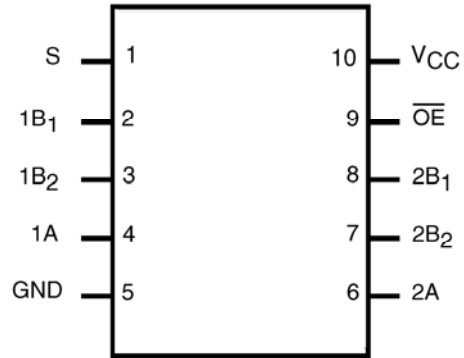
Figure 4. MSOP (Top Through View)

Pin Descriptions

Pin # MicroPak™ / MSOP	Pin # DQFN	Pin Names	Description
1	2	S	Select Input
2, 3, 7, 8	3, 5, 10, 12	$1B_1$, $1B_2$, $2B_2$, $2B_1$	Bus B
5	7	GND	Ground
4, 6	6, 9	1A, 2A	Bus A
9	12	OE	Bus Switch Enable
10	14	V_{CC}	Supply Voltage

Truth Table

S	OE	Function
Don't Care	HIGH	Disconnect
LOW	LOW	$A=B_1$
HIGH	LOW	$A=B_2$

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[1]		-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		±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:
1.   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[2]	0	5	ns/V
		Switch I/O	0	DC	
T_A	Operating Temperature, Free Air		-40	+85	°C

Note:
2.   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°C.

Symbol	Parameter	Condition	V_{CC} (V)	T_A=-40 to +85°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			±1.0	µA
I_{OFF}	Off-State Leakage Current	$0 \leq A, B \leq V_{CC}$	3.6			±1.0	µA
R_{ON}	Switch On Resistance[3]	V_{IN} = 0.8V, I_{ON} = 8mA	3.0		5	7	Ω
		V_{IN} = 3.0V, I_{ON} = 8mA	3.0		4.5	6.5	
ΔR_{ON}	Delta R_{ON}	V_{IN} = 0.8V, V_{IN} = 0V - 1.5V, I_{ON} = 8mA	3.0		0.3		Ω
$R_{FLAT(ON)}$	On Resistance Flatness[4]	I_{OUT} = 8mA	3.0		1		Ω
I_{CC}	Quiescent Supply Current	V_{IN} = V_{CC} or GND, I_{OUT} = 0	3.6			1	µA

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°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 = 50Ω	3.0 to 3.6	-26		dB	Figure 11
X_{TALK}	Non-Adjacent Channel Crosstalk	f = 250MHz, R_L = 50Ω	3.0 to 3.6	-45		dB	Figure 12
BW	-3dB Bandwidth	R_L = 50Ω, C_L = 0pF	3.0 to 3.6	750		MHz	Figure 13
		R_L = 50Ω, C_L = 5pF		435			

USB Related AC Electrical Characteristics

Typical values are at V_{CC} = 3.3V and T_A = 25°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 = 50Ω, 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°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

Freqency Response

C$_L$ = 0pF, V$_{CC}$ = 3.3V
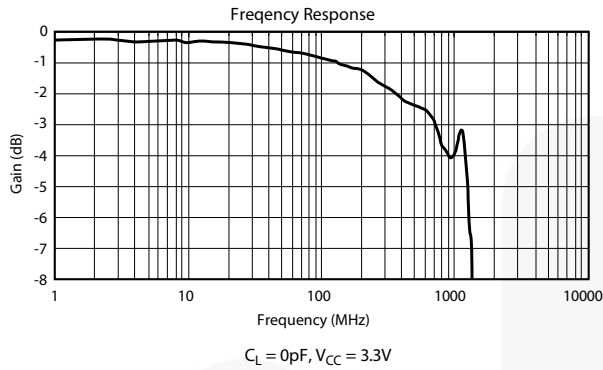
Figure 5.   Gain vs. Frequency

Freqency Response

V$_{BIAS}$ = 0.5V, V$_{CC}$ = 3.3V

Figure 6.   Off Isolation

Freqency Response

V$_{BIAS}$ = 0.5V, V$_{CC}$ = 3.3V

Figure 7.   Crosstalk

85°C
V$_{B2}$ = 800.000mV
R$_{ON}$ = 5.402

-40°C
V$_{B2}$ = 800.000mV
R$_{ON}$ = 3.561

25°C
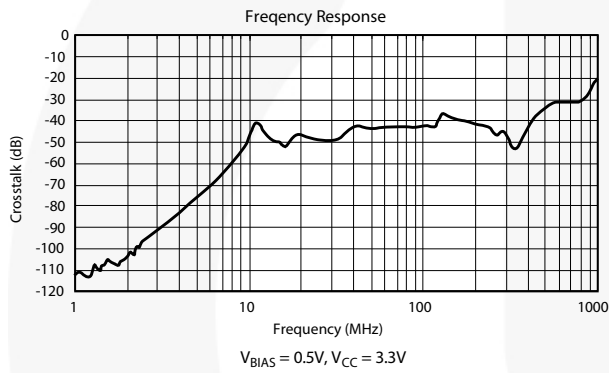V$_{B2}$ = 800.000mV
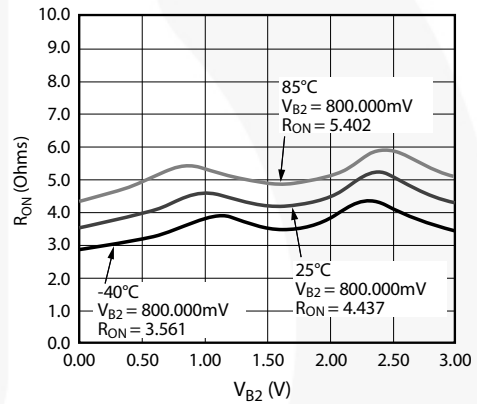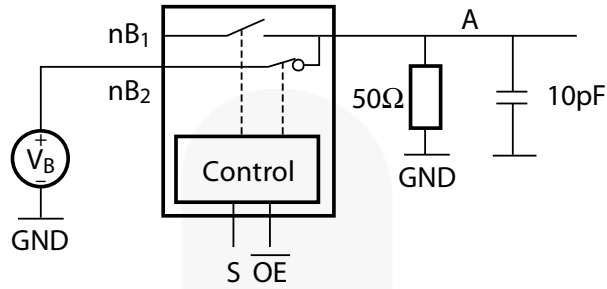R$_{ON}$ = 4.437

Figure 8.   R$_{ON}$

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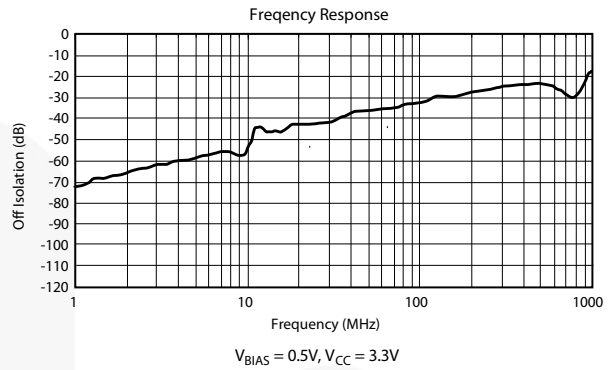
AC Loadings and Waveforms

Notes: Input driven by 50Ω source terminated in 50Ω.
C_L includes load and stray capacitance.
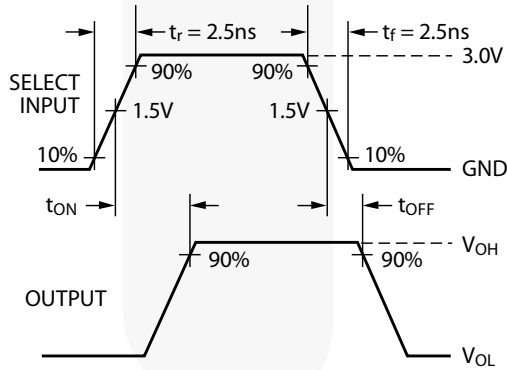Input PRR-1.0MHz, t_W = 500ns.

Figure 9.   AC Test Circuit
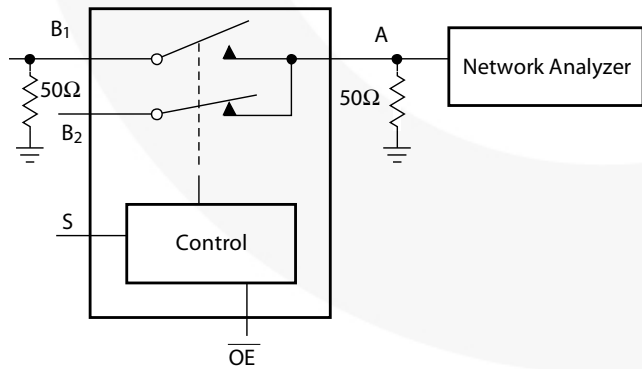
Figure 10. AC Waveforms
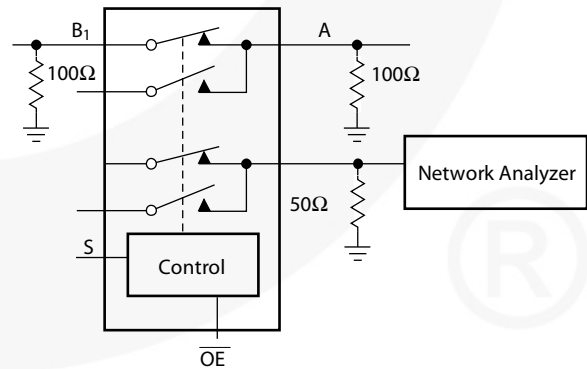
Figure 11. Off Isolation Test

Figure 12. Crosstalk Test

AC Loadings and Waveforms
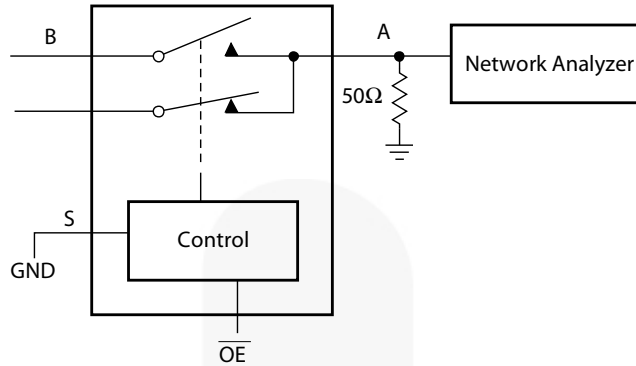
Figure 13. Bandwidth Test
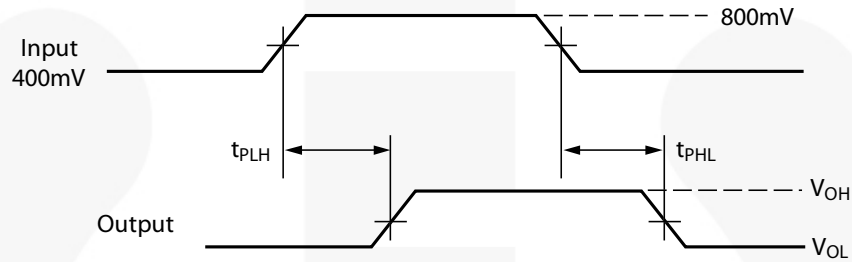
Figure 14. Propagation Delay

$$t_{SK(P)} = |\, t_{PHL} - t_{PHL} \,|$$
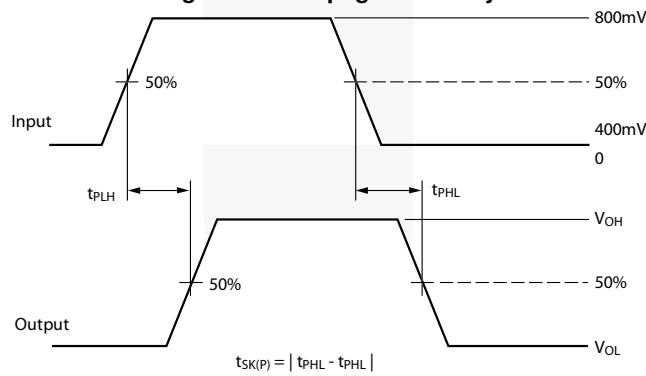
Figure 15. Pulse Skew $t_{SP(P)}$

$$t_{SK(O)} = |\, t_{PLH1} - t_{PLH2} \,| \text{ or } |\, t_{PHL1} - t_{PHL2} \,|$$
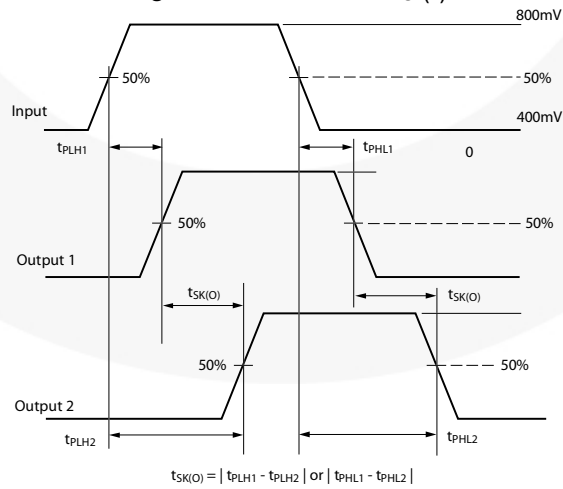
Figure 16. Output Skew $t_{SK(O)}$

Physical Dimensions

△ | 0.10 | C
2X

2.10 ▶ A

B

1.60

PIN1 IDENT IS
2X LONGER THAN
OTHER LINES

△ | 0.10 | C
2X

TOP VIEW

0.55 MAX
∥ | 0.05 | C

△ | 0.05 | C

C

0.05
0.00

SIDE VIEW

DETAIL A

△ D

0.65
0.55

(0.36)

0.35
0.25

1

4

0.56

10

5

(0.29)

9

6

0.50

0.35 9X
0.25

0.25 9X
0.15

1.62

⌖ | 0.10 Ⓜ | C | A | B
| 0.05 Ⓜ | C
ALL FEATURES

BOTTOM VIEW

1.62

(0.11)

0.56

1.12

0.50

KEEPOUT ZONE, NO TRACES
OR VIAS ALLOWED

(0.35) 10X

(0.25) 10X

RECOMMENDED LAND PATTERN

(0.20)

0.35
0.25

(0.15)

0.35
0.25

DETAIL A 2X SCALE

NOTES:
  A. PACKAGE CONFORMS TO JEDEC
     REGISTRATION MO-255, VARIATION UABD .
  B. DIMENSIONS ARE IN MILLIMETERS.
  C. DIMENSIONS AND TOLERANCES PER
     ASME Y14.5M, 1994.
△ D. PRESENCE OF CENTER PAD IS PACKAGE
     SUPPLIER DEPENDENT. IF PRESENT IT
     IS NOT INTENDED TO BE SOLDERED AND
     HAS A BLACK OXIDE FINISH.
  E. DRAWING FILENAME: MKT-MAC10Arev5.
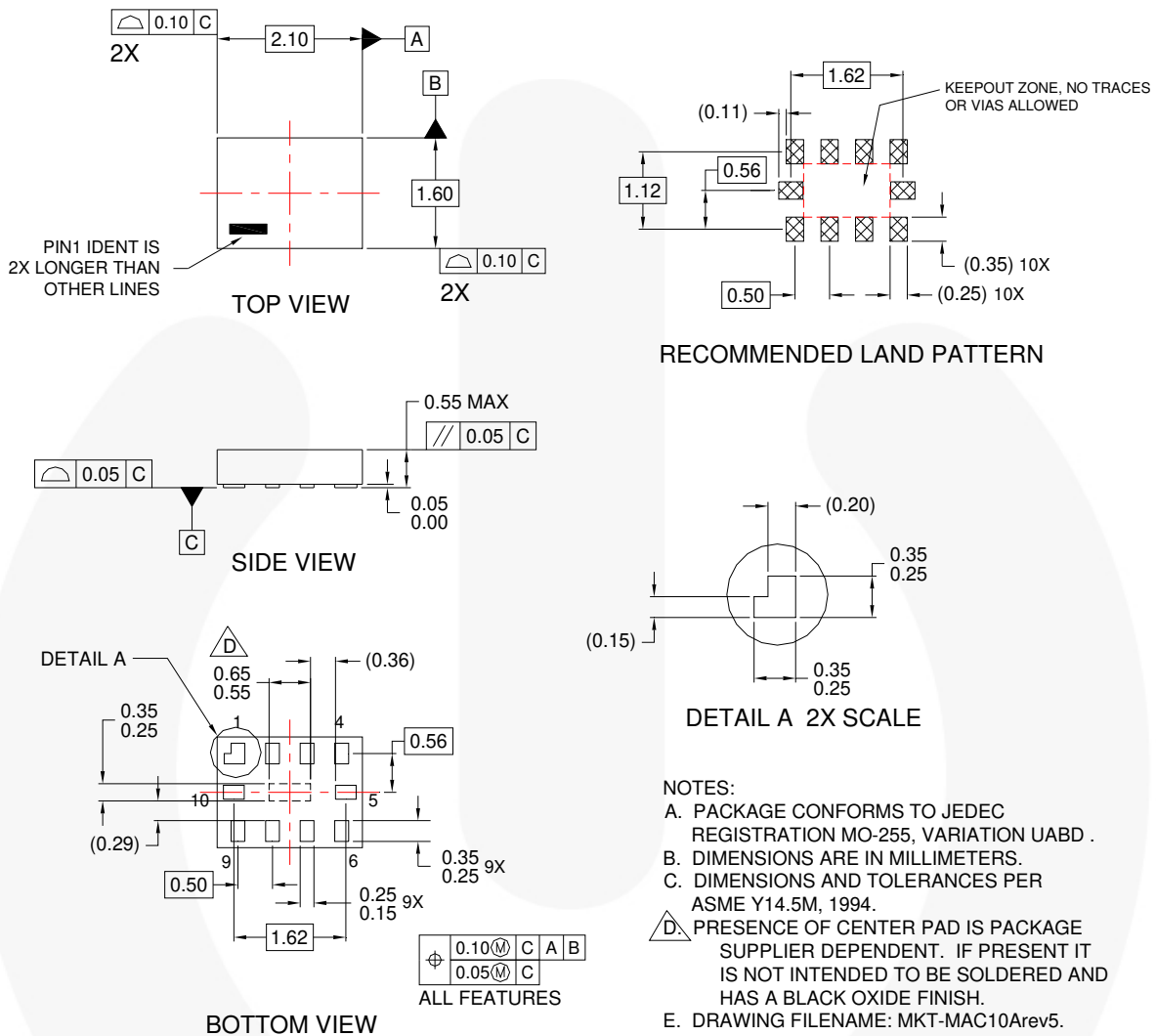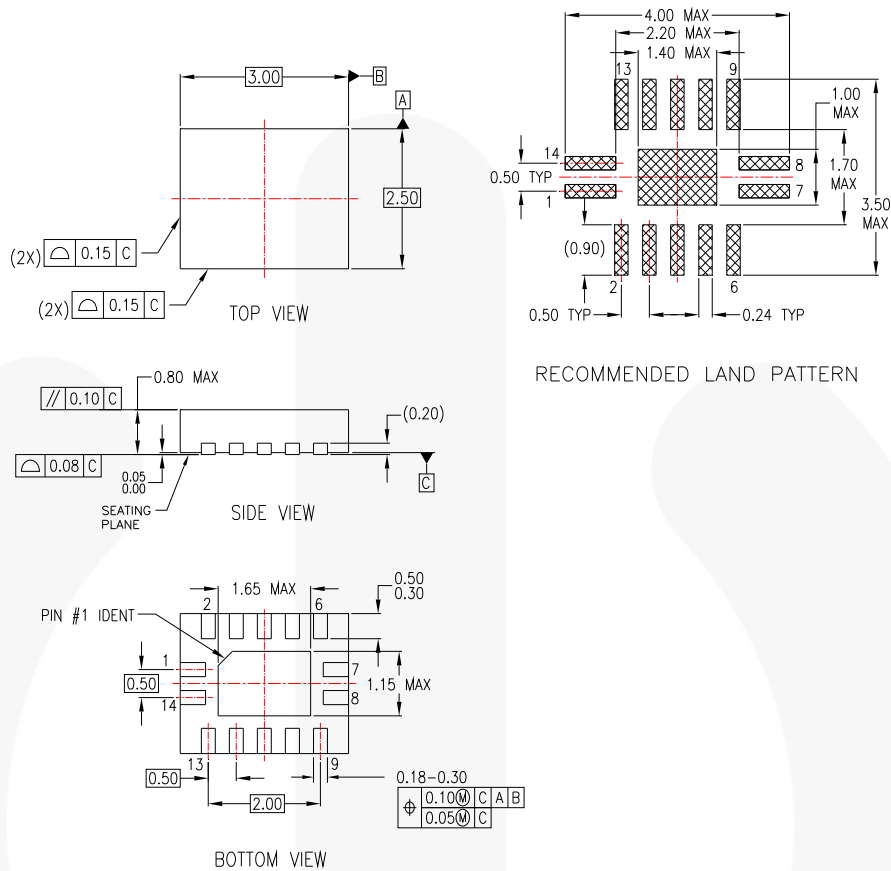
Figure 17. 10-Lead MicroPak™, 1.6 x 2.1mm

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For current tape and reel specifications, visit Fairchild Semiconductor's online packaging area:
http://www.fairchildsemi.com/products/logic/pdf/micropak_tr.pdf.

Physical Dimensions

TOP VIEW

3.00
B
A
2.50
(2X) ⌒ 0.15 C
(2X) ⌒ 0.15 C

RECOMMENDED LAND PATTERN

4.00 MAX
2.20 MAX
1.40 MAX
13
9
1.00 MAX
14
0.50 TYP
8
1.70 MAX
1
7
3.50 MAX
(0.90)
0.50 TYP
2
6
0.24 TYP

SIDE VIEW

0.80 MAX
// 0.10 C
(0.20)
⌒ 0.08 C
0.05
0.00
C
SEATING PLANE

BOTTOM VIEW

PIN #1 IDENT
2
1.65 MAX
6
0.50
0.30
1
7
0.50
1.15 MAX
14
8
13
9
0.50
2.00
0.18-0.30
⌖ 0.10 Ⓜ C A B
0.05 Ⓜ C

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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For current tape and reel specifications, visit Fairchild Semiconductor's online packaging area:
http://www.fairchildsemi.com/ms/MS/MS-522.pdf.

Physical Dimensions

TOP VIEW

1.40 MIN

10   6

(0.30)

4.40

1   5

0.50

0.85±0.10

1.10 MAX

0.15
0.00

0.50

0.10 C
ALL LEAD TIPS

SIDE VIEW

0.27
0.17

.08 M A B C

3.00±0.10

A

B

2.45

4.90

3.00±0.10

PIN #1 ID
QUADRANT

1   5

(0.381)

A

0.23
0.08

END VIEW

12°
TOP & BOTTOM

GAUGE
PLANE

SEATING
PLANE

R0.13 TYP

4°-8°

0.22

0.80
0.40

(0.95)

DETAIL A
SCALE 20 : 1

C

NOTES: UNLESS OTHERWISE SPECIFIED

A. THIS PACKAGE CONFORMS TO JEDEC MO-187
    VARIATION BA.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS,
    MOLD FLASH AND TIE BAR EXTRUSIONS.
D. DIMENSIONS AND TOLERANCES AS PER ASME
    Y14.5-1994.
E. LAND PATTERN AS PER IPC7351#SOP50P490X110-10AN
F. FILE NAME: MKT-MUA10AREV3

Figure 19. 10-Lead Molded Small Outline Package (MSOP), JEDEC MO-187, 3.0mm Wide

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http://www.fairchildsemi.com/products/analog/pdf/msop10_tr.pdf

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CorePLUS™	Green FPS™ e-Series™	Quiet Series™	TinyCalc™
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CTL™	IntelliMAX™	Saving our world, 1mW/W/kW at a time™	TinyPower™
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EfficientMax™	MICROCOUPLER™	SPM®	TRUECURRENT®*
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F®	MicroPak™	SuperFET®	µSerDes™
	MicroPak2™	SuperSOT™-3	
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Fairchild Semiconductor®	MotionMax™	SuperSOT™-8	Ultra FRFET™
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FACT®	mWSaver™	SyncFET™	VCX™
FAST®	OptoHiT™	Sync-Lock™	VisualMax™
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FETBench™	OPTOPLANAR®		XS™
FlashWriter®*			
FPS™			

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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. I61

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