FAIRCHILD SEMICONDUCTOR®

March 2008

FSUSB22 — Low-Power, 2-Port, High-Speed USB 2.0 (480Mbps) Switch

Features

- -40dB Off Isolation at 250MHz
- -40dB Non-adjacent Channel Crosstalk at 250MHz
- On Resistance: 4.5Ω Typical (R_{ON})
- -3dB Bandwidth: 750MHz
- Low-Power Consumption: 1µA Maximum
- Control Input: TTL Compatible
- Bi-directional Operation
- USB High-Speed and Full-Speed Signaling Capability

Applications

- Cell Phones, PDAs, Digital Cameras, Notebook Computers

Description

FSUSB22 is a low-power, high-bandwidth switch specially designed for applications 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 (750MHz) allows signals to pass with minimum edge and phase distortion. Superior channel-to-channel crosstalk results in minimal interference. It is compatible with the USB2.0 Hi-Speed standard.

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Ordering Information

Part Number	Operating Temperature Range	Package	Packing Method
FSUSB22BQX	-40 to +85°C	16-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.5mm	Tape and Reel
FSUSB22QSC	-40 to +85°C	16-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150-inch Wide	Tube
FSUSB22QSCX	-40 to +85°C	16-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150-inch Wide	Tape and Reel
FSUSB22MTC	-40 to +85°C	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide	Tube
FSUSB22MTCX	-40 to +85°C	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide	Tape and Reel

All packages are lead free per JEDEC: J-STD-020B standard.

Logic Diagram

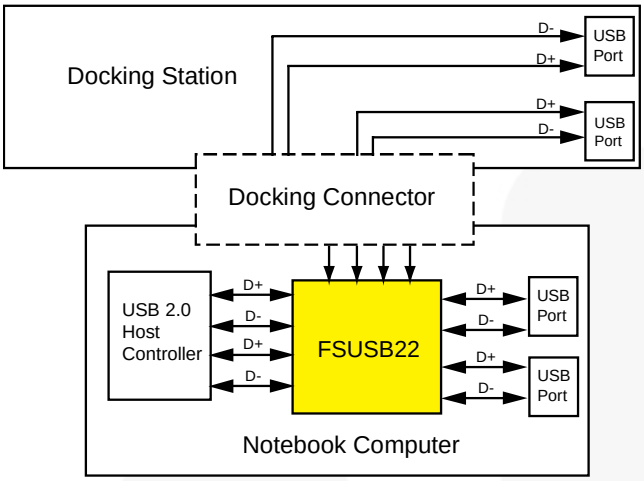


Figure 1. Logic Diagram

Analog Symbol

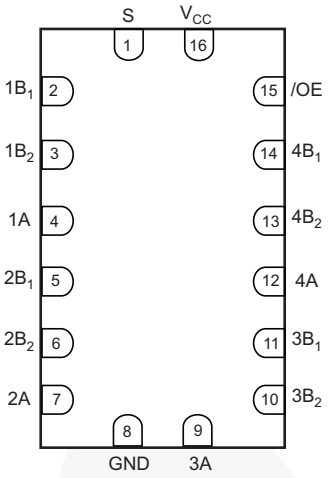


Figure 2. Analog Symbol

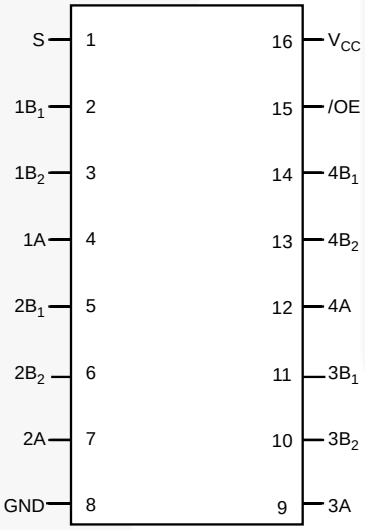


Figure 3. QSOP and TSSOP Pin Configuration

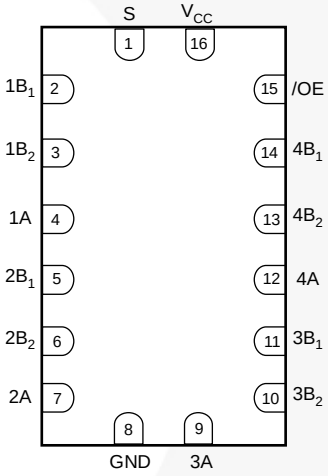


Figure 4. Pad Assignment for DQFN

Pin Descriptions

Pin #	Pin Names	Description
1	S	Select Input
2,3,5,6,10,11,13,14	$1B_1$,$1B_2$, $2B_1$,$2B_2$,$3B_2$,$3B_1$,$4B_2$,$4B_1$	Bus B
8	GND	Ground
4,7,9,12	1A,2A,3A,4A	Bus A
15	/OE	Bus Switch Enable
16	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		128	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		4	kV

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	Conditions	V_{CC} (V)	T_A=-40 to +85°C			Units
				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	$0 \le V_{IN} \le 3.6V$	3.6			±1.0	µA
I_{OFF}	Off-state Leakage Current	$0 \le A, B \le V_{CC}$	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 - 1.5, 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} = 3.0V and T_A = 25°C.

Symbol	Parameter	Conditions	V_{CC}(V)	Min.	Typ.	Max.	Units	Figure
t_{ON}	Turn-on Time S-to-Bus B		3.0 to 3.6		4.5	6.0	ns	Figure 9 Figure 10
t_{OFF}	Turn-off Time S-to-Bus B		3.0 to 3.6		2.5	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		-30		dB	Figure 11
X_{TALK}	Non-Adjacent Channel Crosstalk	f = 250MHz, R_L = 50Ω	3.0 to 3.6		-38		dB	Figure 12
BW	-3dB Bandwidth	R_L = 50Ω	3.0 to 3.6		750		MHz	Figure 13

USB Related AC Electrical Characteristics

Typical values are at V_{CC} = 3.0V and T_A = 25°C.

Symbol	Parameter	Conditions	V_{CC} (V)	Min.	Typ.	Max.	Units	Figure
$t_{SK(O)}$	Channel-to Channels Skew	C_L = 10pF	3.0 to 3.6		0.051		pF	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		pF	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		0.210			

Capacitance

Typical values are at V_{CC} = 3.0V and T_A = 25°C.

Symbol	Parameter	Conditions	Typ.	Unists
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	pF
C_{OFF}	Port B Off Capacitance	V_{CC} and /OE = 3.3V	4.5	pF

Performance Characteristics

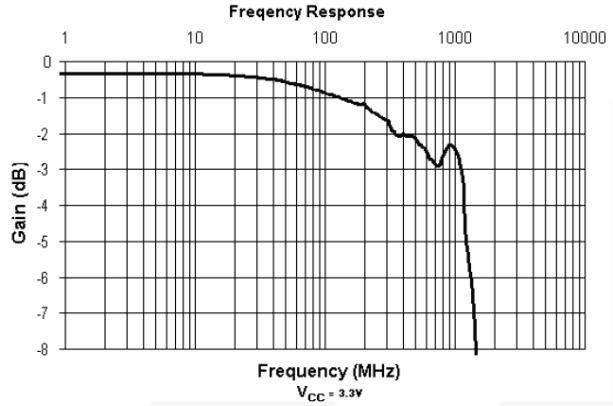


Figure 5. Gain vs. Frequency

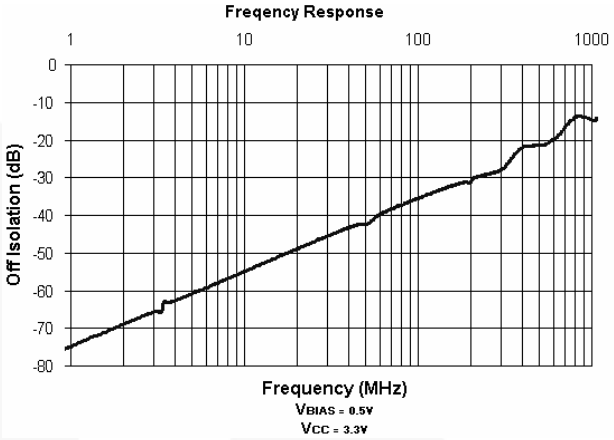


Figure 6. Off Isolation

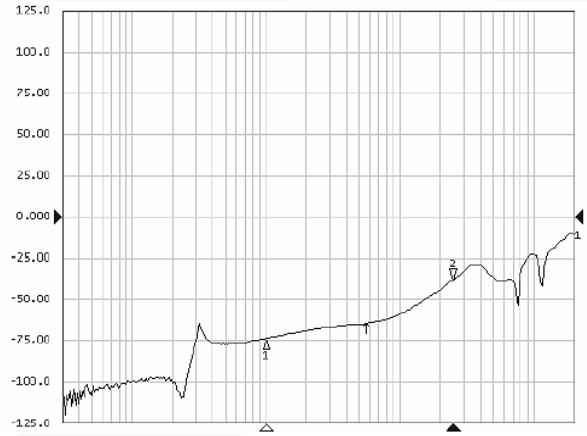


Figure 7. Crosstalk

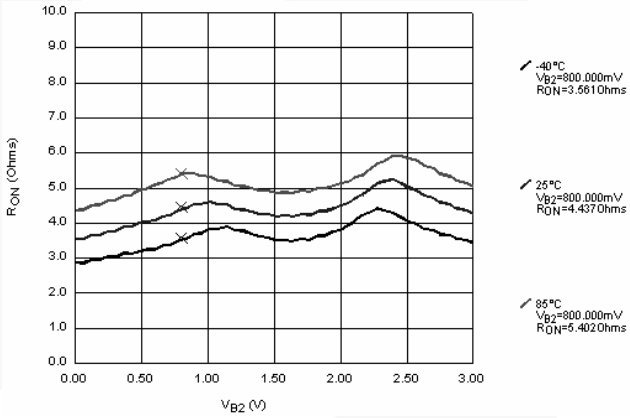
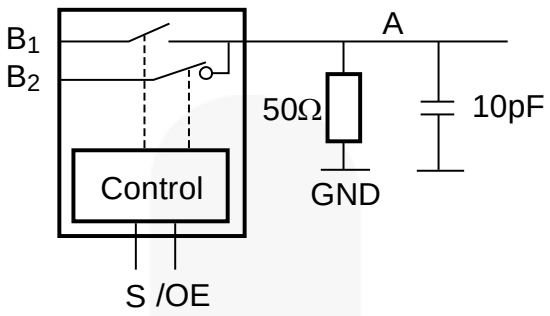


Figure 8. R_{ON}

AC Loadings and Waveforms



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

Figure 9. AC Test Circuit

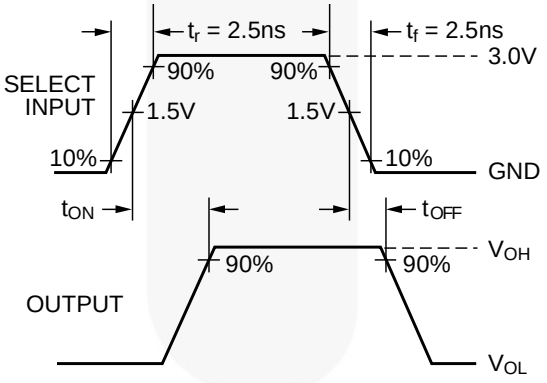


Figure 10. AC Waveforms

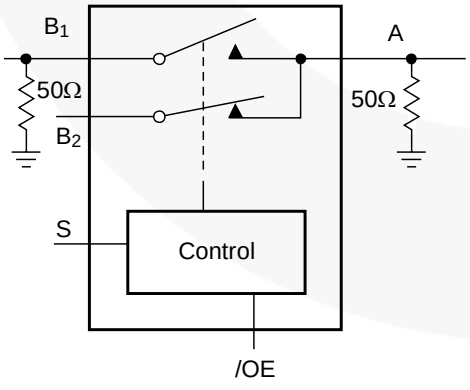


Figure 11. Off Isolation Test

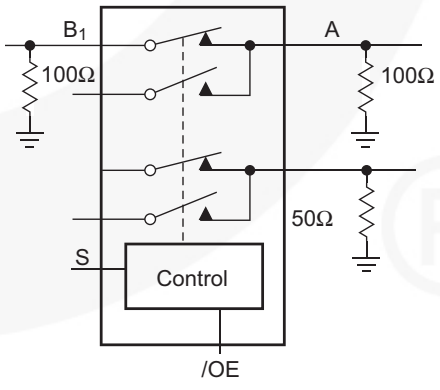


Figure 12. Crosstalk Test

AC Loadings and Waveforms

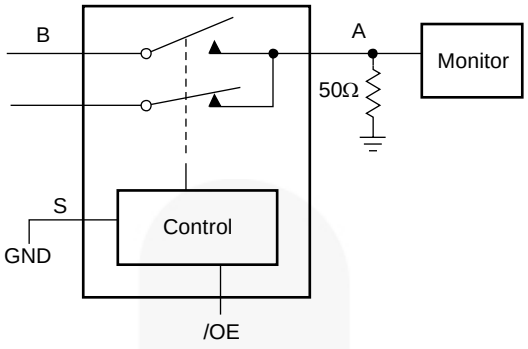


Figure 13. Bandwidth Test

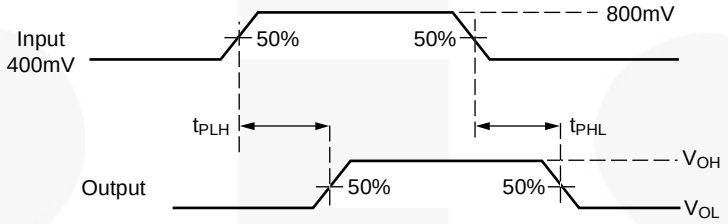
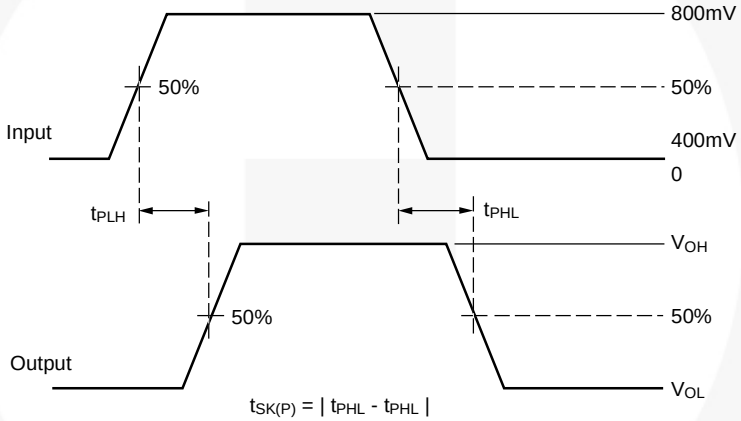
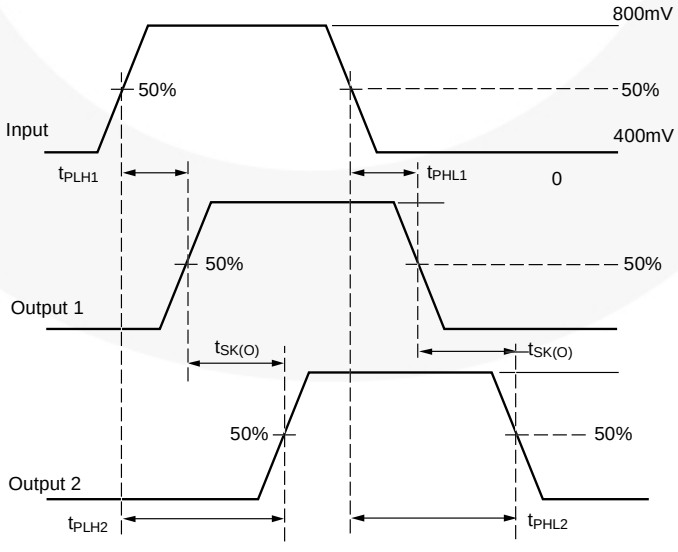


Figure 14. Propagation Delay



$t_{SK(P)} = | t_{PHL} - t_{PHL} |$

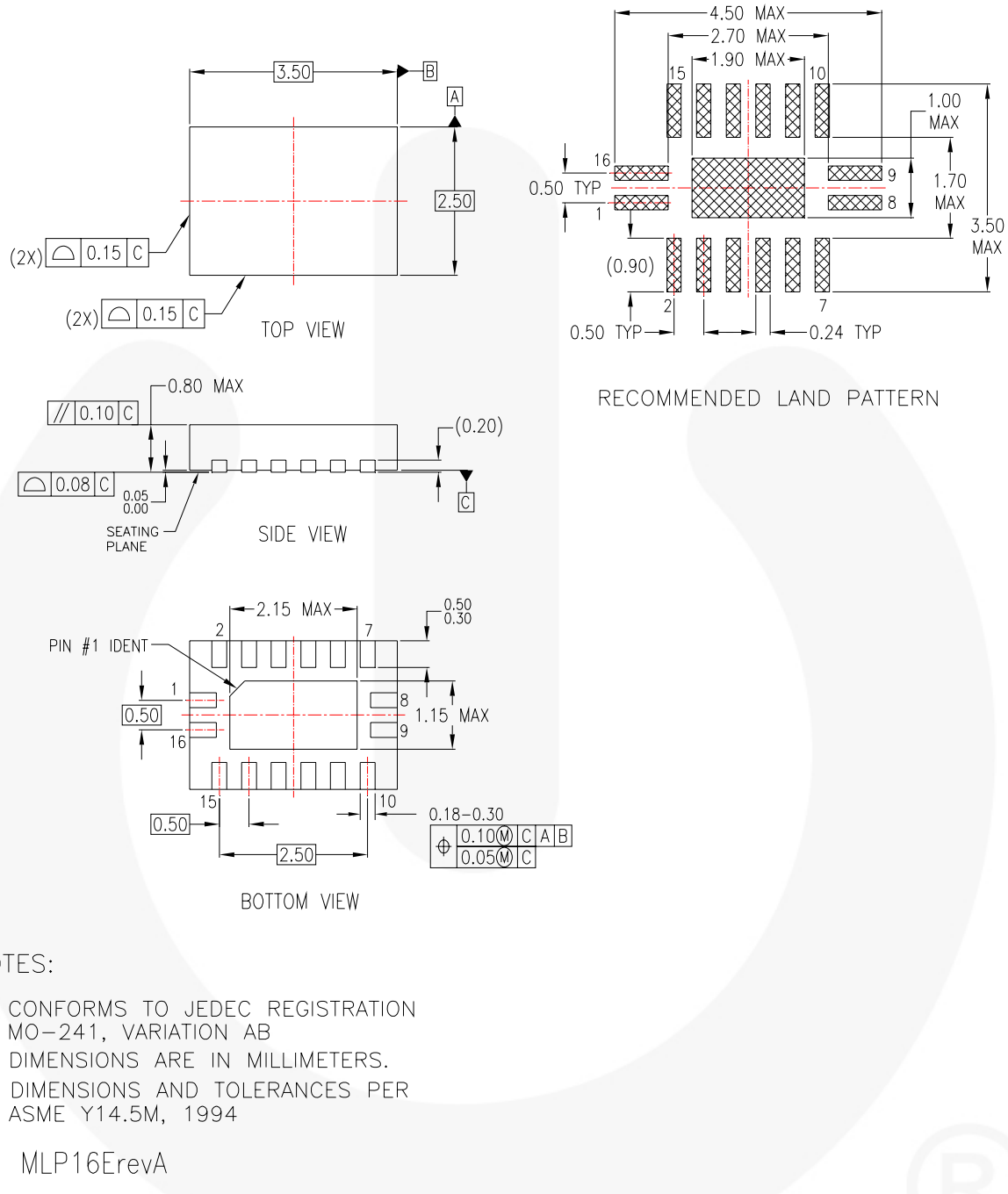
Figure 15. Pulse Skew $t_{SP(P)}$



$t_{SK(O)} = | t_{PLH1} - t_{PLH2} |$ or $| t_{PHL1} - t_{PHL2} |$

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

Physical Dimensions



NOTES:

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

MLP16ErevA

Figure 17. 16-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241,2.5 x 3.5mm

Note: click here for tape and reel specifcations, available at:

http://www.fairchildsemi.com/products/analog/pdf/MLP16_25x35_TNR.pdf

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Physical Dimensions

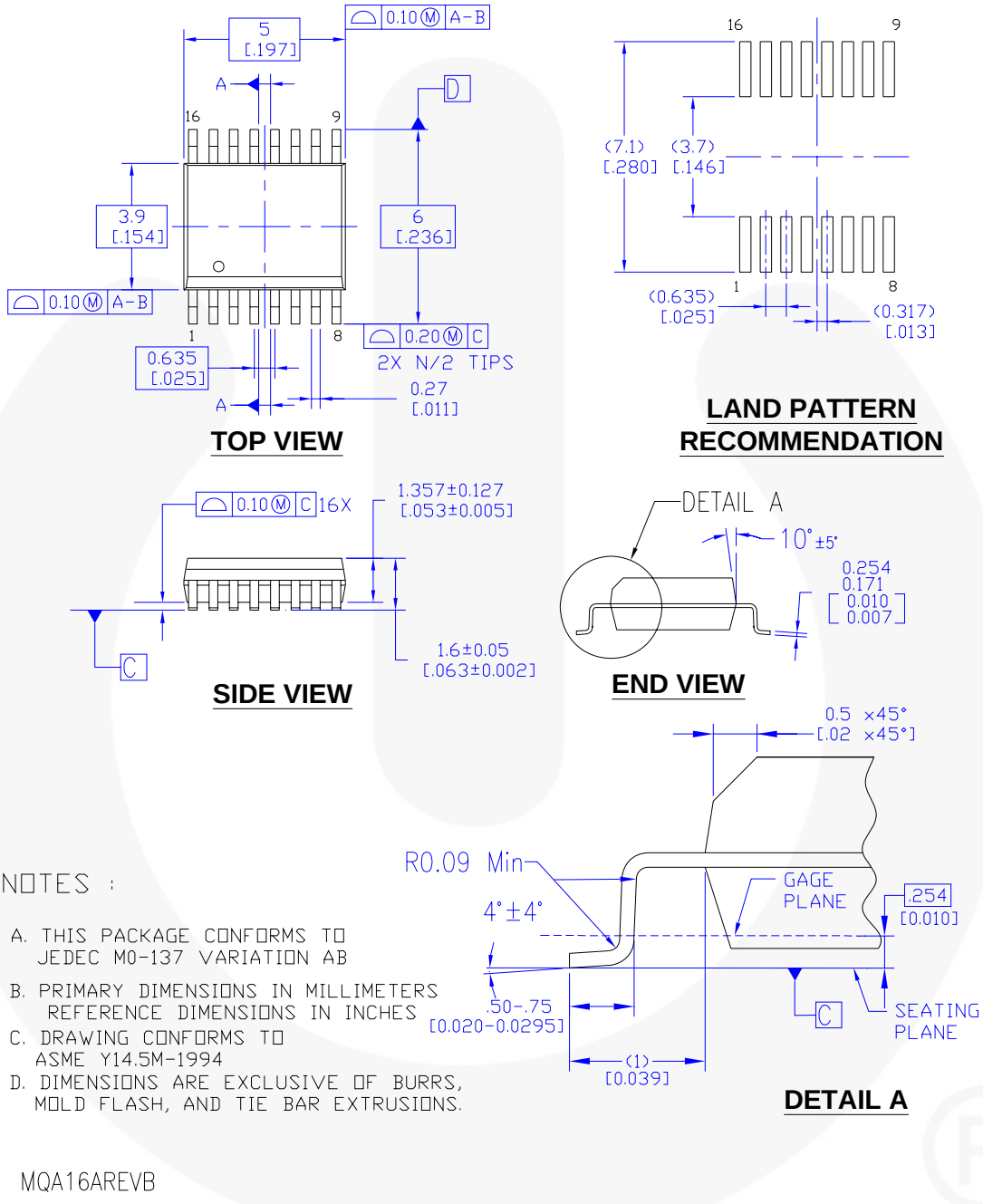

Figure 18. 16-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150-inch Wide

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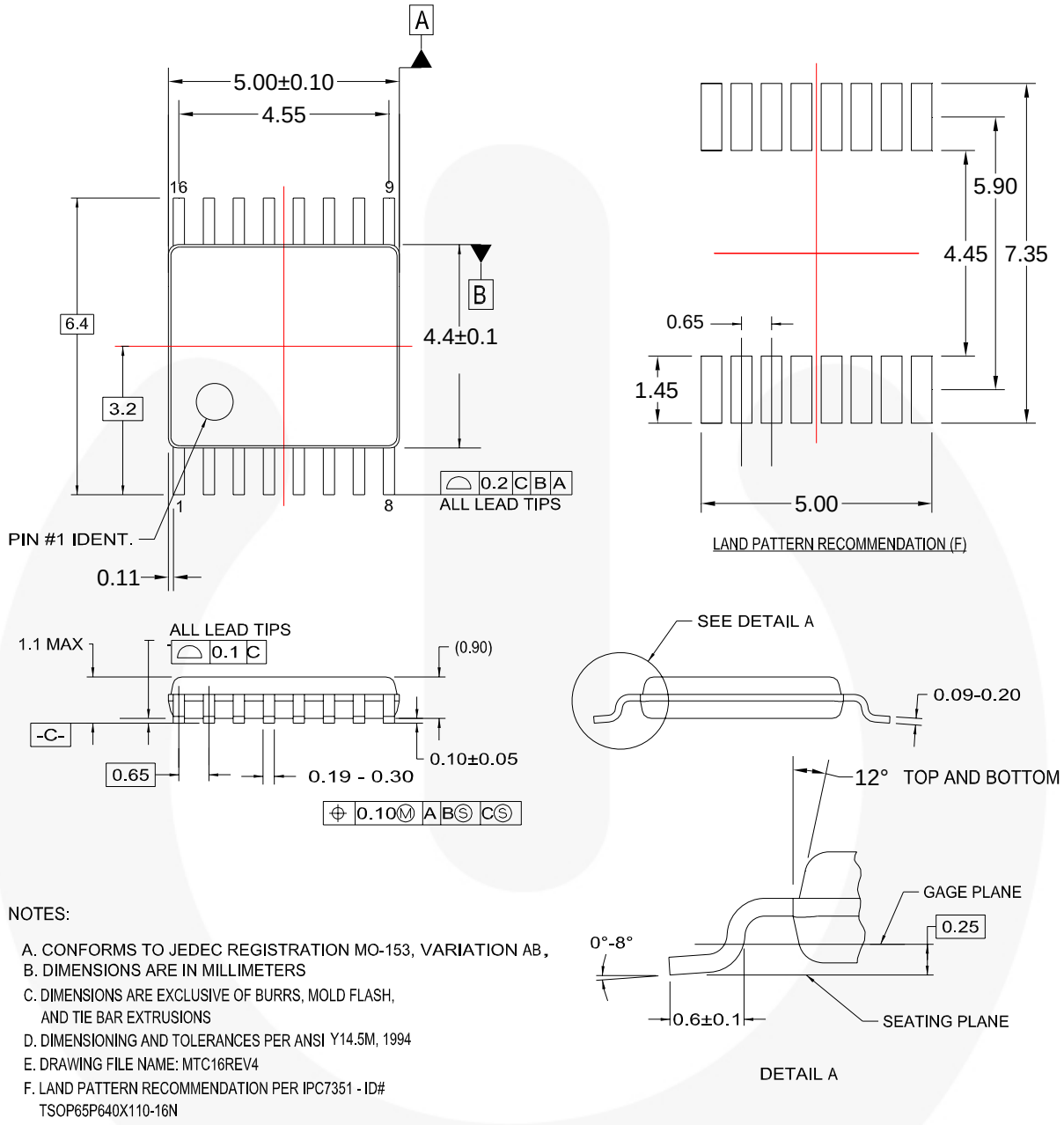
Physical Dimensions



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D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1994
E. DRAWING FILE NAME: MTC16REV4
F. LAND PATTERN RECOMMENDATION PER IPC7351 - ID# TSOP65P640X110-16N

MTC16rev4

Figure 19. 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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