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# FSUSB11 — Low-Power, Full-Speed (12Mbps) Switch

## Features

- Space Saving MicroPak™ (1.6 x 2.1mm)
- USB 1.1 Signal Switching Compliant
- 3db Bandwidth: >350MHz
- Maximum 1.15Ω R<sub>ON</sub> at 4.5V V<sub>CC</sub> and 4Ω for 2.7V Supply
- 0.3Ω Maximum R<sub>ON</sub> Flatness for +5V Supply
- Broad V<sub>CC</sub> Operating Range: 1.65V to 5.5V
- Fast Turn-On and Turn-Off Time
- Break-Before-Make Enable Circuitry
- Over-Voltage Tolerant, TTL-Compatible Control Input

## Description

The FSUSB11 is a high-performance, dual Single-Pole Double-Throw (SPDT) switch designed for switching USB 1.1 signals. The device features ultra-low on resistance (R<sub>ON</sub>) of 1.15Ω maximum at 4.5V V<sub>CC</sub> and 4.3Ω at 2.7V supply. High bandwidth and ultra low (R<sub>ON</sub>) make this switch able to pass both USB low- and full-speed signal with minimum signal distortion. The device is fabricated with sub-micron CMOS technology to achieve fast switching speeds and designed for break-before-make operation. The select input is TTL-level compatible.

## Applications

- Cell Phones, PDAs, Digital Cameras, Notebook Computers

## Ordering Information

Part Number	Operating Temperature Range	Eco Status	Package	Packing Method
FSUSB11L10X	-40 to +85°C	RoHS	10-Lead, MicroPak™, JEDEC MO255, 1.6 X 2.1mm	Tape and Reel
FSUSB11MTCX	-40 to +85°C	RoHS	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide	Tape and Reel

For Fairchild's definition of Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

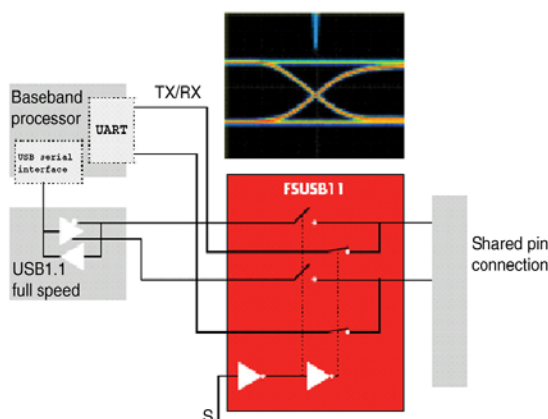


Figure 1. Block Diagram

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

## Pin Configuration

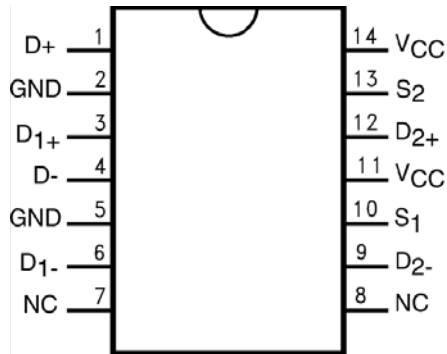


Figure 2. TSSOP Pin Assignment (Top View)

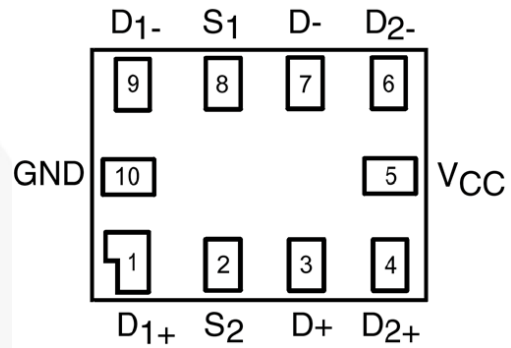


Figure 3. Micropak™ Pin Assignment (Top View)

## Analog Symbol

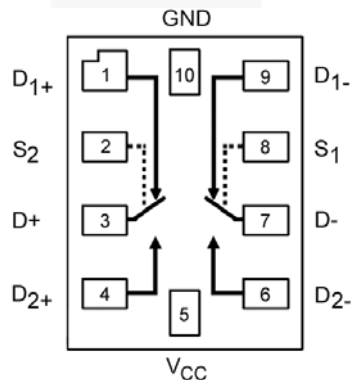


Figure 4. Analog Symbol

## Pin Descriptions

TSSOP Pin #	MicroPak™ Pin #	Pin Names	Description
1, 3, 4, 6, 9, 12	1, 3, 4, 6, 7, 9	D+, D <sub>1+</sub> , D-, D <sub>1-</sub> , D <sub>2-</sub> , D <sub>2+</sub>	Data Ports
2, 5	10	GND	Ground
7, 8		NC	No Connect
10, 13	2, 8	S <sub>1</sub> , S <sub>2</sub>	Control Input
11, 14	5	V <sub>CC</sub>	Supply Voltage

## Truth Table

Control Inputs	Function
Low Logic Level	D <sub>1</sub> Connected to D+/D-
High Logic Level	D <sub>2</sub> Connected to D+/D-

## 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	6.0	V
$V_S$	Switch Voltage	-0.5	$V_{CC} + 0.5$	V
$V_{IN}$	Input Voltage <sup>(1)</sup>	-0.5	6.0	V
$I_{IK}$	Input Diode Current	-50		mA
$I_{SW}$	Switch Current		200	mA
$I_{SWPEAK}$	Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle)		400	mA
$T_{STG}$	Storage Temperature Range	-65	+150	°C
$T_J$	Maximum Junction Temperature		+150	°C
$T_L$	Lead Temperature (Soldering, 10 Seconds)		+260	°C
ESD	Human Body Model, JESD22-A114		8	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	1.65	5.50	V
$V_{IN}$	Control Input Voltage <sup>(2)</sup>	0	$V_{CC}$	$V_{CC}$
$V_{SW}$	Switch Input Voltage	0	$V_{CC}$	$V_{CC}$
$T_A$	Operating Temperature	-40	+85	°C

**Note:**

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

## DC Electrical Characteristics

Unless otherwise specified, typical values are at +25°C.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C		Units	
				Min.	Typ.	Max.	Min.	Max.		
V <sub>IH</sub>	Input Voltage High		2.7 to 3.6				2.0		V	
			4.5 to 5.5				4.0			
V <sub>IL</sub>	Input Voltage Low		2.7 to 3.6						V	
			4.5 to 5.5							
I <sub>IN</sub>	Control Input Leakage	V <sub>IN</sub> =0V to V <sub>CC</sub>	2.7 to 3.6						μA	
			4.5 to 5.5							
I <sub>NO(OFF)</sub> , I <sub>NO(OFF)</sub>	Off-Leakage Current of Port D <sub>1</sub> and D <sub>2</sub>	A=1V, 4.5V, B <sub>0</sub> or B <sub>1</sub> =1V, 4.5V	5.5	-50		50	-100	100	nA	
I <sub>A(ON)</sub>	On-Leakage Current of Port D	A=1V, 4.5V, B <sub>0</sub> or B <sub>1</sub> =1V, 4.5V or Floating	5.5	50		50	-100	100	nA	
R <sub>ON</sub>	Switch On Resistance <sup>(3)</sup>	Micropak	I <sub>OUT</sub> = 100mA, D <sub>1</sub> or D <sub>2</sub> =1.5V	2.7		2.60	4.00		4.30	Ω
			I <sub>OUT</sub> = 100mA, D <sub>1</sub> or D <sub>2</sub> =3.5V	4.5		0.95	1.15		1.30	
		TSSOP	I <sub>OUT</sub> = 100mA, D <sub>1</sub> or D <sub>2</sub> =1.5V	2.7		2.80			4.50	
			I <sub>OUT</sub> = 100mA, D <sub>1</sub> or D <sub>2</sub> =3.5V	4.5		1.50			3.00	
ΔR <sub>ON</sub>	On Resistance Matching Between Channel <sup>(4)</sup>	Micropak	I <sub>OUT</sub> = 100mA, D <sub>1</sub> or D <sub>2</sub> =3.5V	4.5		0.06	0.12		0.15	Ω
		TSSOP				0.07		0.30		
R <sub>FLAT(ON)</sub>	On Resistance Flatness <sup>(5)</sup>		I <sub>OUT</sub> =100mA, D <sub>1</sub> or D <sub>2</sub> =0V, 0.75V, 1.5V	2.7		1.4				Ω
			I <sub>OUT</sub> =100mA, B <sub>0</sub> or B <sub>1</sub> =0V, 1V, 2V	4.5		0.2	0.3		0.4	
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> =0V or V <sub>CC</sub> , I <sub>OUT</sub> =0	3.6		0.1	0.5		1.0	μA	
			5.5		0.1	0.5		1.0		

### Notes:

3. On resistance is determined by the voltage drop between D and Dn pins at the indicated current through the switch.
4. ΔR<sub>ON</sub> = R<sub>ONmax</sub> - R<sub>ONmin</sub> measured at identical V<sub>CC</sub>, temperature, and voltage.
5. Flatness is defined as the difference between the maximum and minimum value of on resistance over the specified range of conditions.

## AC Electrical Characteristics

Unless otherwise specified, typical values are at +25°C.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C		Units	Figure
				Min.	Typ.	Max.	Min.	Max.		
t <sub>ON</sub>	Turn-on Time S-to-Bus B	D <sub>1</sub> or D <sub>2</sub> =1.5V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	2.7 to 3.6			50		60	ns	Figure 5
		D <sub>1</sub> or D <sub>2</sub> =3.0V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	4.5 to 5.5			35		30		
t <sub>OFF</sub>	Turn-off Time S-to-Bus B	D <sub>1</sub> or D <sub>2</sub> =1.5V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	2.7 to 3.6			20		20	ns	Figure 5
		D <sub>1</sub> or D <sub>2</sub> =3.0V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	4.5 to 5.5			15				
t <sub>BBM</sub>	Break-Before-Make Time	D <sub>1</sub> or D <sub>2</sub> =1.5V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	2.7 to 3.6				1		ns	Figure 6
		D <sub>1</sub> or D <sub>2</sub> =3.0V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	4.5 to 5.5		20		1			
Q	Charge Injection	C <sub>L</sub> =1.0nF, V <sub>GEN</sub> =0V, R <sub>GEN</sub> =0Ω	2.7 to 3.6		20				pC	Figure 8
			4.5 to 5.5		10					
O <sub>IRR</sub>	Off Isolation	f=1MHz, R <sub>L</sub> =50Ω	2.7 to 3.6		-70				dB	Figure 7
			4.5 to 5.5		-70					
X <sub>TALK</sub>	Non-Adjacent Channel Crosstalk	f=1MHz, R <sub>L</sub> =50Ω	2.7 to 3.6		-75				dB	Figure 7
			4.5 to 5.5		-75					
BW	-3dB Bandwidth	R <sub>L</sub> =50Ω	2.7 to 3.6		350				MHz	Figure 10
			4.5 to 5.5		350					

## USB Related AC Electrical Characteristics

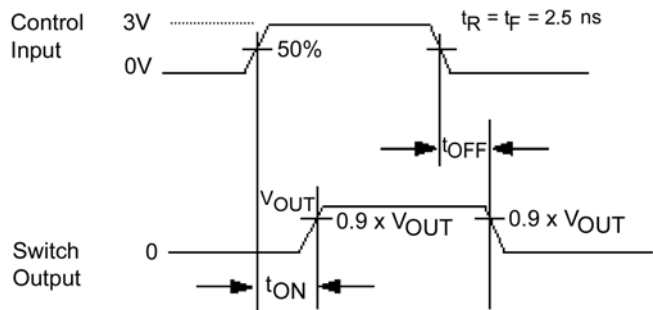
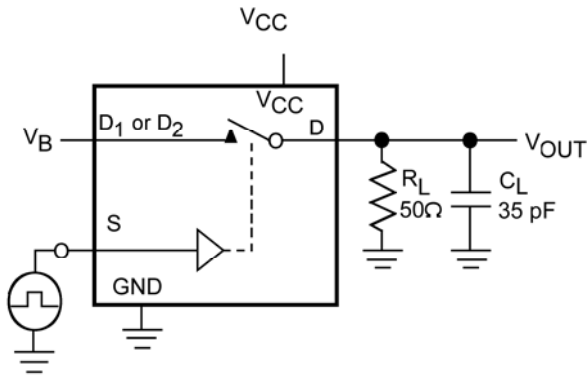
Unless otherwise specified, typical values are at 25°C.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			Units	Figure
				Min.	Typ.	Max.		
t <sub>SK(O)</sub>	Skew	R <sub>S</sub> =39, C <sub>L</sub> =50pF, t <sub>R</sub> =t <sub>F</sub> =12ns at 12Mbps	2.7 to 3.6		0.15		ns	Figure 11
			4.5 to 5.5		0.15			
t <sub>SK(P)</sub>	Rising/Fall Time Mismatch	(Duty Cycle=50%)	2.7 to 3.6		30		ps	Figure 12
			4.5 to 5.5		20			
T <sub>J</sub>	Total Jitter	R <sub>S</sub> =39, C <sub>L</sub> =50pF, t <sub>R</sub> =t <sub>F</sub> =12ns at 12Mbps (PRBS=2 <sup>15</sup> -1)	2.7 to 3.6		1.7		ps	Figure 12
			4.5 to 5.5		1.6			

## Capacitance

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			Units	Figure
				Min.	Typ.	Max.		
C <sub>IN</sub>	Control Pin Input Capacitance	f=1MHz	0.0		3.5		pF	Figure 9
C <sub>OFF</sub>	D <sub>n</sub> Port Off Capacitance	f=1MHz	4.5		12.0		pF	Figure 9
C <sub>ON</sub>	D Port On Capacitance	f=1MHz	4.5		40.0		pF	Figure 9

### AC Loadings and Waveforms



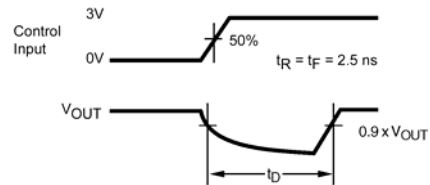
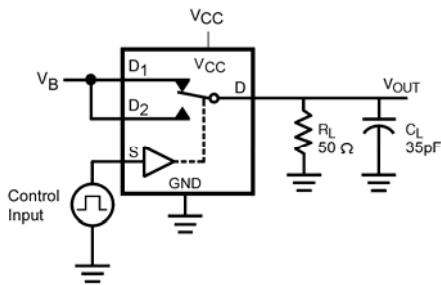
**Note:**

6.  $C_L$  includes fixture and stray capacitance.

**Note:**

7. Logic input waveforms inverted for switches that have the opposite logic sense.

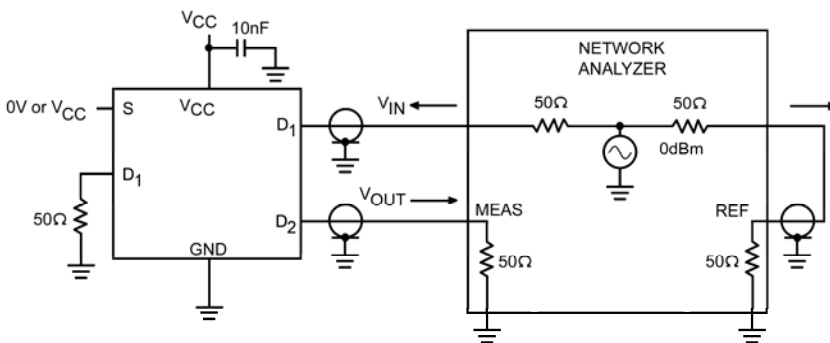
**Figure 5. Turn On/ Turn Off Timing**



**Note:**

8.  $C_L$  includes fixture and stray capacitance.

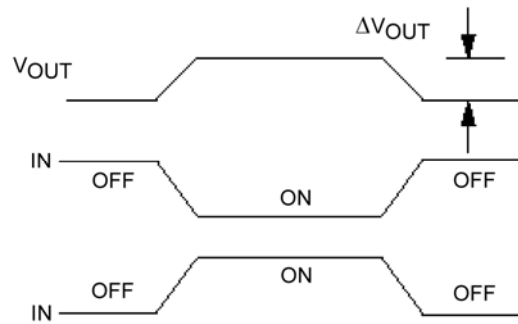
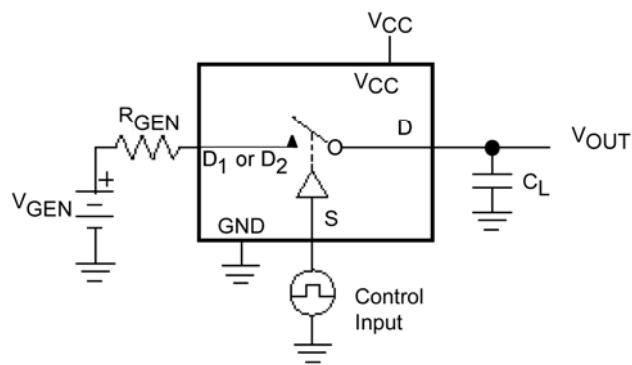
**Figure 6. Break-Before-Make Timing**



$$\begin{aligned} \text{OFF-ISOLATION} &= 20 \log \frac{V_{OUT}}{V_{IN}} \\ \text{ON-LOSS} &= 20 \log \frac{V_{OUT}}{V_{IN}} \\ \text{CROSSTALK} &= 20 \log \frac{V_{OUT}}{V_{IN}} \end{aligned}$$

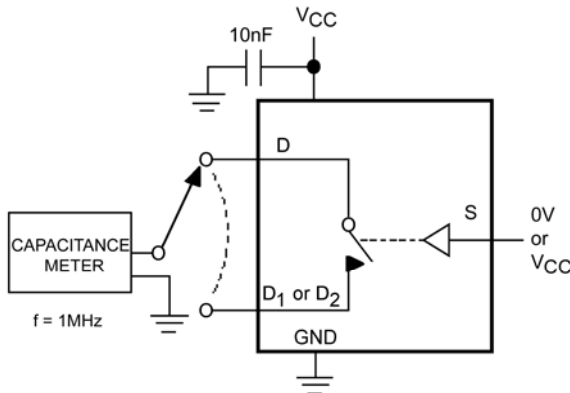
**Figure 7. Off Isolation and Crosstalk**

### AC Loadings and Waveforms (Continued)

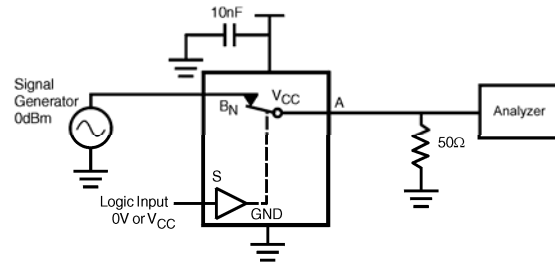


**Note:**  
9.  $Q = (\Delta V_{OUT}) (C_L)$ .

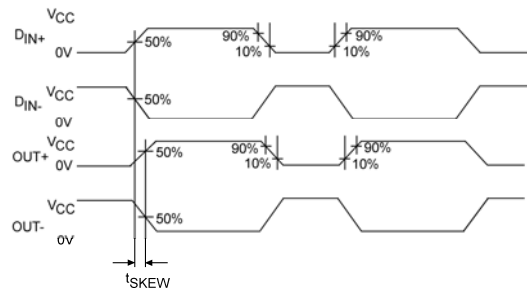
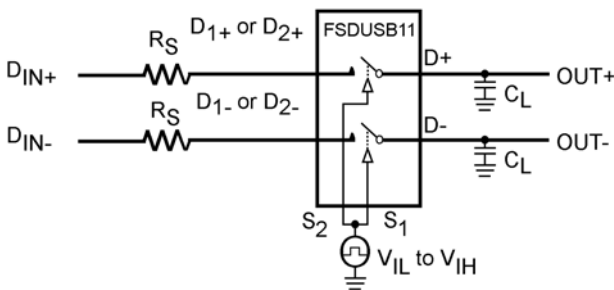
**Figure 8. Charge Injection**



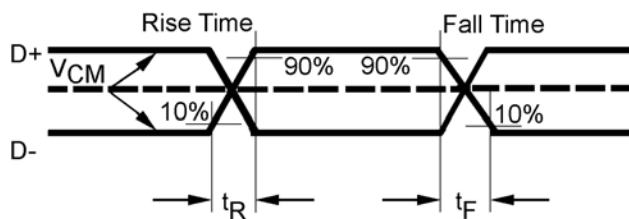
**Figure 9. On/Off Capacitance Measurement Setup**



**Figure 10. Bandwidth**



**Figure 11. Skew Test**



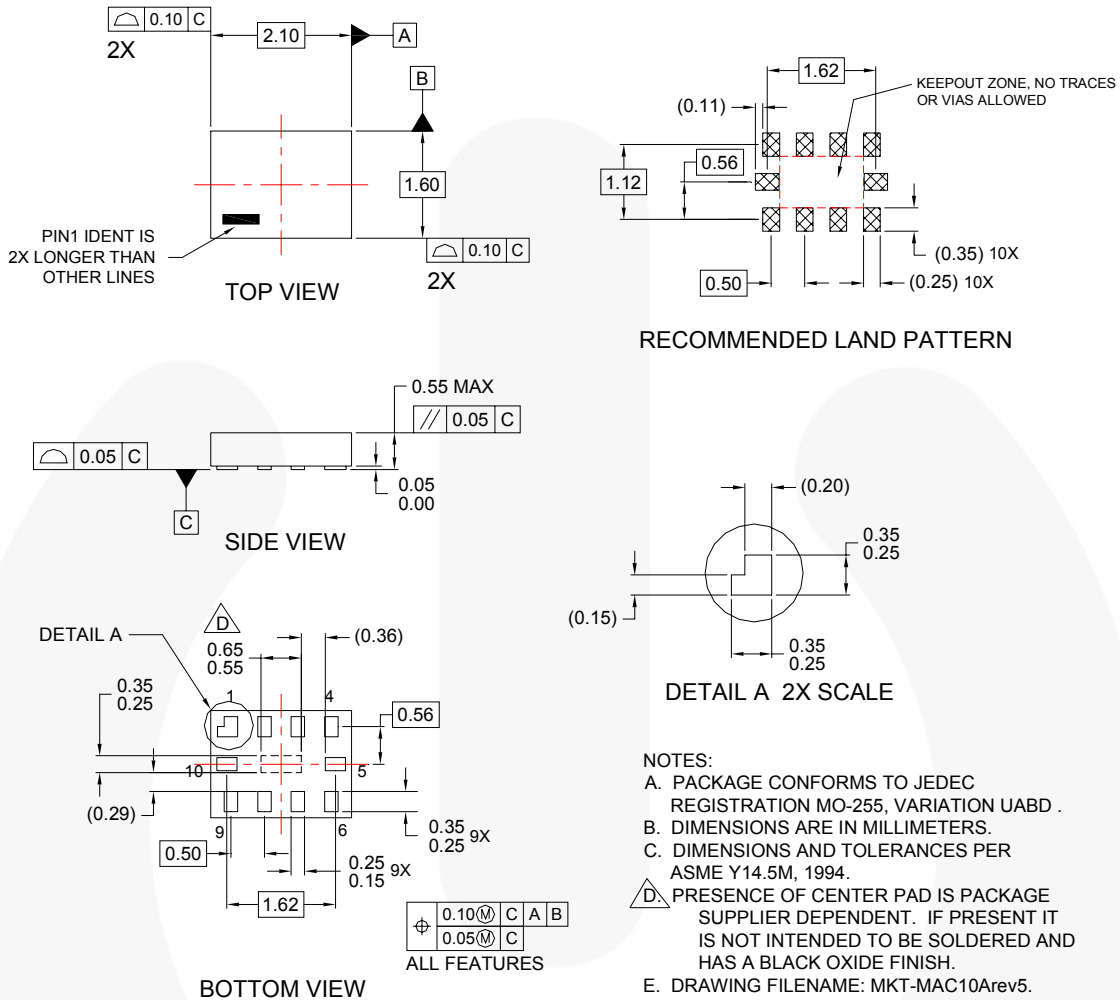
$$1.3V < V_{CM} < 2V$$

$$t_M = \frac{|t_R - t_F|}{\min(t_R, t_F)}$$

**Figure 12. Rise/Fall Time Mismatch Test**



## Physical Dimensions



**Figure 13. 10-Lead, MicroPak™, JEDEC MO255, 1.6 X 2.1mm**

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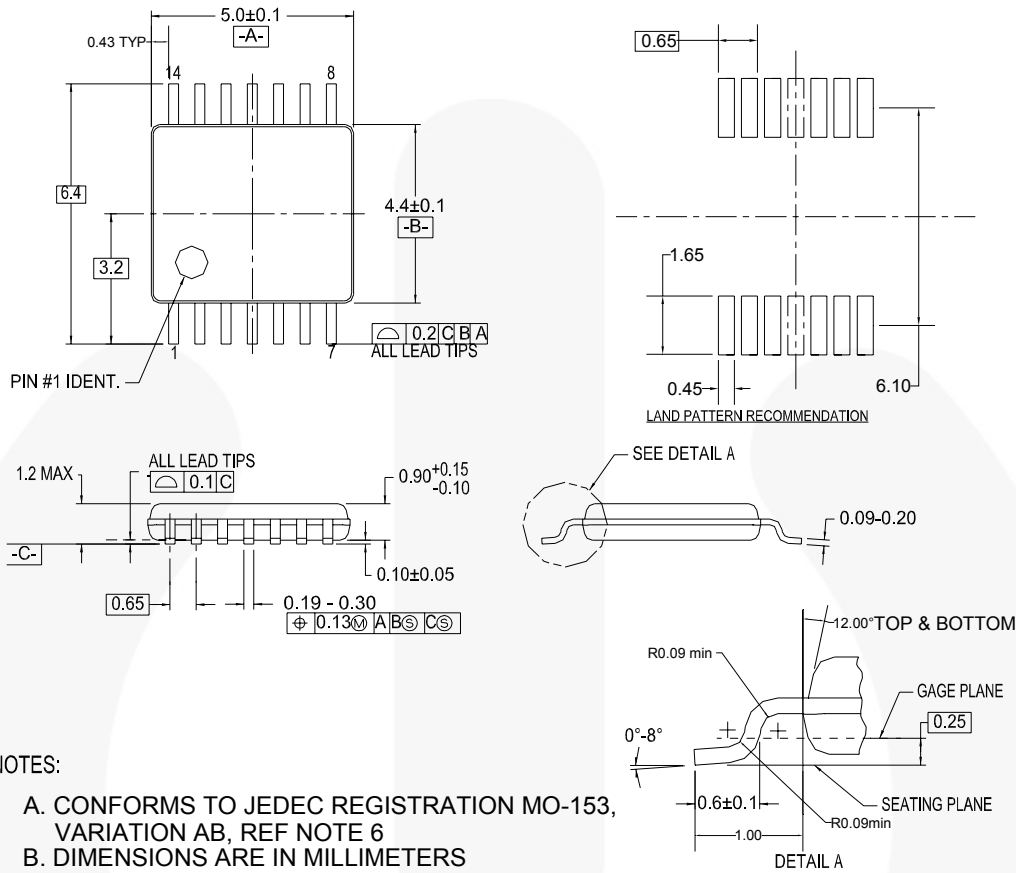
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## Tape and Reel Specification

Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications:  
[http://www.fairchildsemi.com/products/logic/pdf/micropak\\_tr.pdf](http://www.fairchildsemi.com/products/logic/pdf/micropak_tr.pdf).

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

## Physical Dimensions



### NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6
- B. DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982
- E. LANDPATTERN STANDARD: SOP65P640X110-14M
- F. DRAWING FILE NAME: MTC14REV6

**Figure 14. 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide**








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| CorePLUS™  | FRFET®   | Programmable Active Droop™   | TinyBoost™  |
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| Current Transfer Logic™  | Gmax™  | RapidConfigure™  | TINYOPTO™   |
| EcoSPARK®  | GTO™   |  TM | TinyPower™  |
| EfficientMax™  | IntelliMAX™  | Saving our world, 1mW/W/KW at a time™  | TinyPWM™  |
| EZSWITCH™*   | ISOPLANAR™   | SignalWise™  | TinyWire™   |
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| FAST®  | OPTOLOGIC®   | SuperSOT™.8  | VCX™  |
| FastvCore™   | OPTOPLANAR®  | SupreMOS™  | VisualMax™  |
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