

# FSA2257 Low $R_{ON}$ Low-Voltage Dual SPDT Bi-Directional Analog Switch

## Features

- Maximum 1.15 $\Omega$  ON Resistance ( $R_{ON}$ ) for 4.5V supply
- 0.3 $\Omega$  max  $R_{ON}$  flatness for +5V supply
- Space-saving Pb-Free MicroPak™ packaging
- Broad  $V_{CC}$  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 FSA2257 is a high-performance bi-directional dual Single-Pole/Double-Throw (SPDT) analog switch. This switch can be configured as either a multiplexer or a de-multiplexer by select pins. The device features ultra-low  $R_{ON}$  of 1.3 $\Omega$  maximum at 4.5V  $V_{CC}$  and operates over the wide  $V_{CC}$  range of 1.65V to 5.5V. The device is fabricated with submicron CMOS technology to achieve fast switching speeds and is designed for break-before-make operation. The select input is TTL-level compatible.

## Applications

- Cell Phone
- PDA
- Ultra-Portable

## Ordering Information

Order Number	Package Number	Pb-Free	Product Code Top Mark	Package Description	Packing Method
FSA2257L10X <sup>(1)</sup>	MAC010A	Yes	EP	10-Lead MicroPak, 1.6mm x 2.1mm	5K Units on Tape and Reel
FSA2257MTCX <sup>(1)</sup>	MTC14	Yes	FSA2257	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide	2500 Units on Tape and Reel
FSA2257MUX <sup>(1)</sup> (Preliminary)	MUA101A	Yes	FSA2257	10-Lead Molded Small Outline Package (MSOP), JEDEC MO-187, 3.0mm	3K Units on Tape and Reel

### Note:

1. Lead-free package per JEDEC J-STD-020B. Device available in tape and reel only .

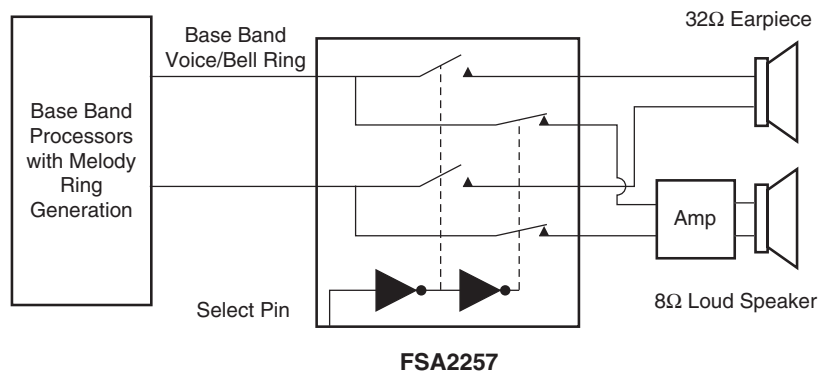
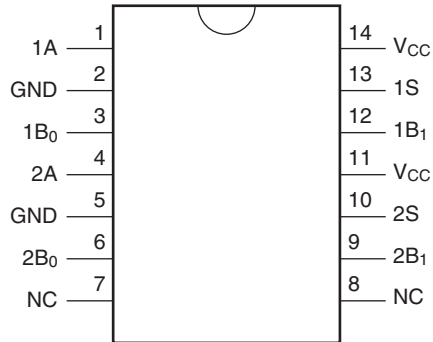


Figure 1. Block Diagram

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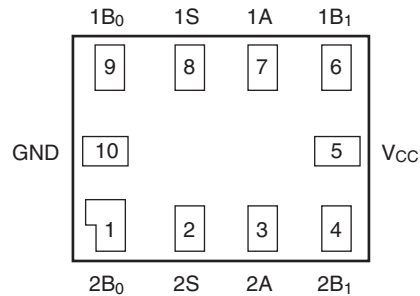
## Connection Diagrams

**Pin Assignments for TSSOP**



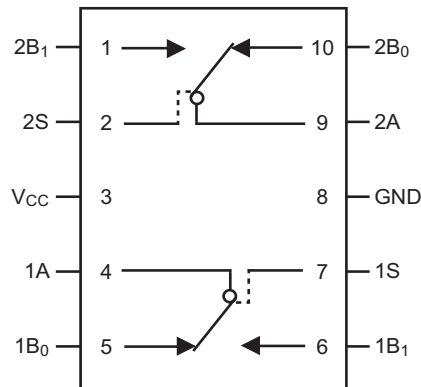
(Top View)

**Pad Assignments for MicroPak**



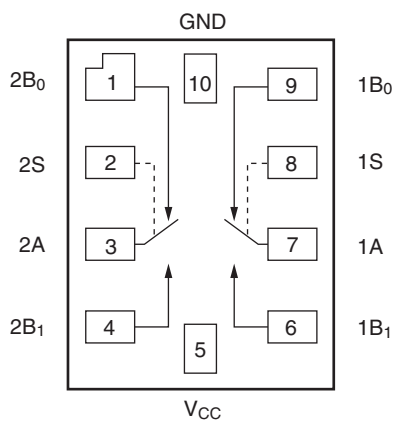
(Top View)

**Pin Assignments for MSOP**



(Top Through View)

## Analog Symbols



(Top Through View)

## Truth Table

Control Input(s)	Function
LOW Logic Level	B <sub>0</sub> Connected to A
HIGH Logic Level	B <sub>1</sub> Connected to A

## Pin Descriptions

Pin Names	Function
A, B <sub>0</sub> , B <sub>1</sub>	Data Ports
S	Control Input

## 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 defines the conditions for actual device operation.

Symbol	Parameter	Min.	Max.	Unit
$V_{CC}$	Supply Voltage	-0.5	+6.0	V
$V_S$	DC Switch Voltage <sup>(2)</sup>	-0.5	$V_{CC} + 0.5$	V
$V_{IN}$	DC Input Voltage <sup>(2)</sup>	-0.5	+6.0	V
$I_{IK}$	Input Diode Current	-50		mA
	Switch Current		200	
	Peak Switch Current (pulsed at 1mS duration, <10% duty cycle)		400	
$T_{STG}$	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		8000	V

## Recommended Operating Conditions

Symbol	Parameter	Min.	Max.	Unit
$V_{CC}$	Supply Voltage	1.65	5.5	V
$V_{IN}$	Control Input Voltage <sup>(3)</sup>	0	$V_{CC}$	$V_{CC}$
$V_{IN}$	Switch Input Voltage	0	$V_{CC}$	$V_{CC}$
$T_A$	Operating Temperature	-40	+85	°C

### Notes:

- The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.
- Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> = -40°C 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				2.4		
V <sub>IL</sub>	Input Voltage Low		2.7 to 3.6					0.6	V
			4.5 to 5.5					0.8	
I <sub>IN</sub>	Control Input Leakage	V <sub>IN</sub> = 0V to V <sub>CC</sub>	2.7 to 3.6				-1.0	1.0	μA
			4.5 to 5.5				-1.0	1.0	
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	OFF-Leakage Current of Port B <sub>0</sub> and B <sub>1</sub>	A = 1V, 4.5V, B <sub>0</sub> or B <sub>1</sub> = 1V, 4.5V	5.5	-2.0		2.0	-20.0	20.0	nA
I <sub>A(ON)</sub>	ON Leakage Current of Port A	A = 1V, 4.5V, B <sub>0</sub> or B <sub>1</sub> = 1V, 4.5V or Floating	5.5	-4.0		4.0	-40.0	40.0	nA
R <sub>ON</sub>	Switch ON Resistance MicroPak <sup>(4)</sup>	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 1.5V	2.7		2.6	4.0		4.3	Ω
		I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 3.5V	4.5		0.95	1.15		1.3	
	Switch ON Resistance TSSOP <sup>(4)</sup>	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 1.5V	2.7		2.8			4.5	
		I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 3.5V	4.5		1.5			3.0	
ΔR <sub>ON</sub>	ON Resistance Matching 5between Channels <sup>(4)</sup> MicroPak	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 3.5V	4.5		0.06	0.12		0.15	Ω
	ON Resistance Matching 5between Channels <sup>(5)</sup> TSSOP	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 3.5V	4.5		0.7			0.3	
R <sub>FLAT(ON)</sub>	ON Resistance Flatness <sup>(6)</sup>	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</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> = 0V	3.6		0.1	0.5		1.0	μA
			5.5		0.1	0.5		1.0	

**Notes:**

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

## AC Electrical Characteristics

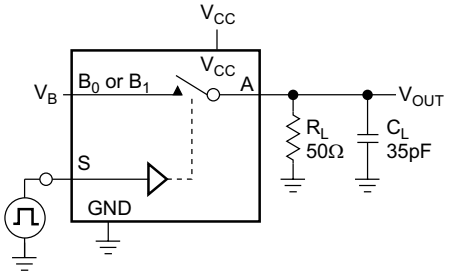
All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C			Figure Number
				Min.	Typ.	Max.	Min.	Max.	Units	
t <sub>ON</sub>	Turn-ON Time	B <sub>0</sub> or B <sub>1</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	2.7 to 3.6			50.0		60.0	ns	Figure 1
		B <sub>0</sub> or B <sub>1</sub> = 3.0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	4.5 to 5.5			35.0		40.0		
t <sub>OFF</sub>	Turn-OFF Time	B <sub>0</sub> or B <sub>1</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	2.7 to 3.6			20.0		30.0	ns	Figure 1
		B <sub>0</sub> or B <sub>1</sub> = 3.0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	4.5 to 5.5			15.0		20.0		
t <sub>B-M</sub>	Break-Before-Make Time	B <sub>0</sub> or B <sub>1</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	2.7 to 3.6				1.0		ns	Figure 2
		B <sub>0</sub> or B <sub>1</sub> = 3.0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	4.5 to 5.5		20.0		1.0			
Q	Charge Injection	C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω	2.7 to 3.6		20.0				pC	Figure 4
			4.5 to 5.5		10.0					
OIRR	OFF Isolation	f = 1MHz, R <sub>L</sub> = 50Ω	2.7 to 3.6		-70.0				dB	Figure 3
			4.5 to 5.5		-70.0					
Xtalk	Crosstalk	f = 1MHz, R <sub>L</sub> = 50Ω	2.7 to 3.6		-75.0				dB	Figure 3
			4.5 to 5.5		-75.0					
BW	-3db Bandwidth	R <sub>L</sub> = 50Ω	2.7 to 3.6		350				MHz	Figure 6
			4.5 to 5.5		350					
THD	Total Harmonic Distortion	R <sub>L</sub> = 600Ω, V <sub>IN</sub> = 0.5V P.P, f = 20Hz to 20kHz	2.7 to 3.6		0.002				%	Figure 7
			4.5 to 5.5		0.002					

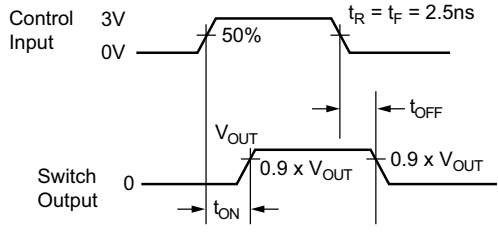
## Capacitance

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C			T <sub>A</sub> = 40°C to +85°C		Units	Figure Number
				Min.	Typ.	Max.	Min.	Max.		
C <sub>IN</sub>	Control Pin Input Capacitance	f = 1MHz	0.0		3.5				pF	Figure 5
C <sub>OFF</sub>	B Port OFF Capacitance	f = 1MHz	4.5		12.0				pF	Figure 5
C <sub>ON</sub>	A Port ON Capacitance	f = 1MHz	4.5		40.0				pF	Figure 5

**AC Loading and Waveforms**

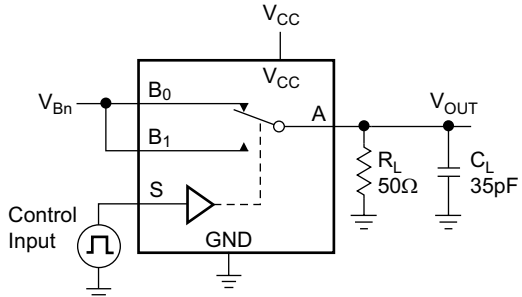


$C_L$  Includes Fixture and Stray Capacitance

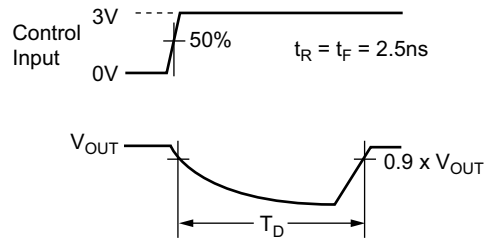


Logic Input Waveforms Inverted for Switches that have the Opposite Logic Sense

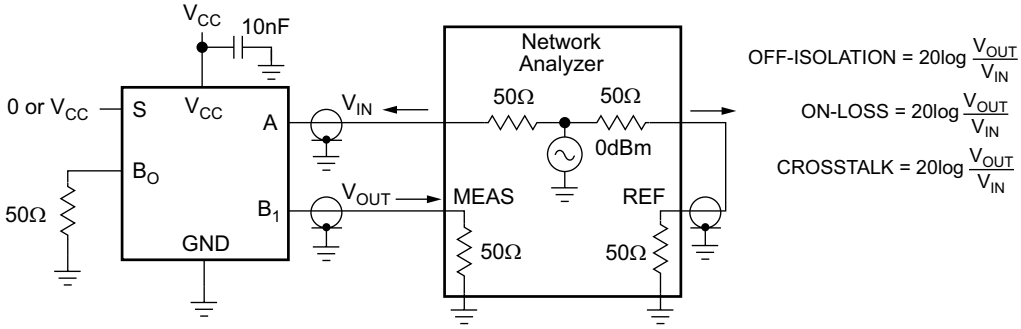
**Figure 2. Turn-On/Turn-Off Timing**



$C_L$  Includes Fixture and Stray Capacitance



**Figure 3. Break-Before-Make Timing**



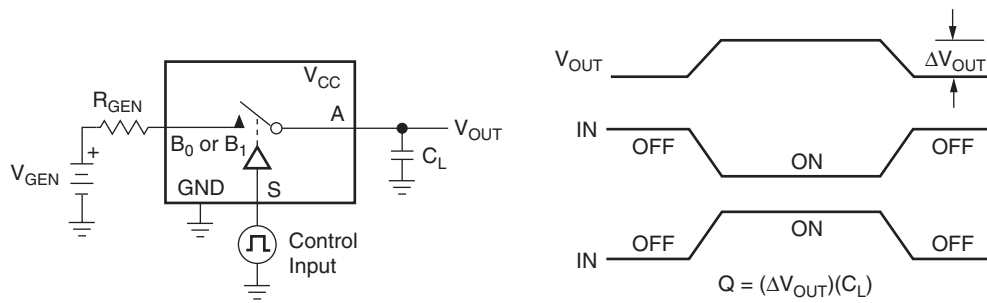
$$\text{OFF-ISOLATION} = 20 \log \frac{V_{\text{OUT}}}{V_{\text{IN}}}$$

$$\text{ON-LOSS} = 20 \log \frac{V_{\text{OUT}}}{V_{\text{IN}}}$$

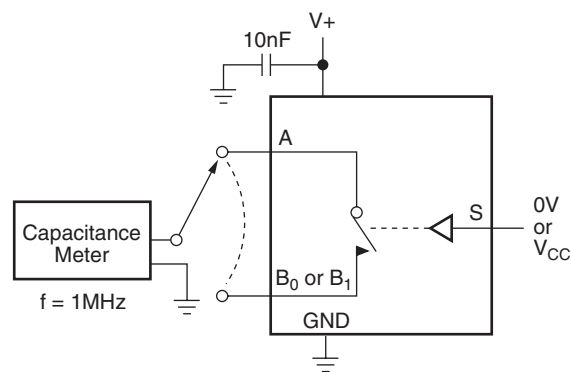
$$\text{CROSSTALK} = 20 \log \frac{V_{\text{OUT}}}{V_{\text{IN}}}$$

**Figure 4. OFF Isolation and Crosstalk**

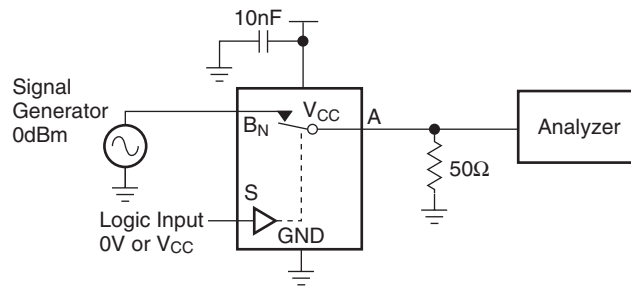
**AC Loading and Waveform** (continued)



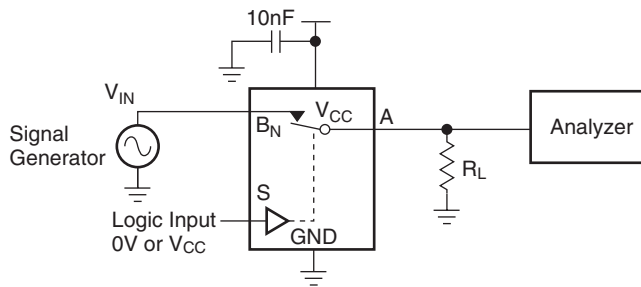
**Figure 5. Charge Injection**



**Figure 6. ON/OFF Capacitance Measurement Setup**



**Figure 7. Bandwidth**



**Figure 8. Harmonic Distortion**

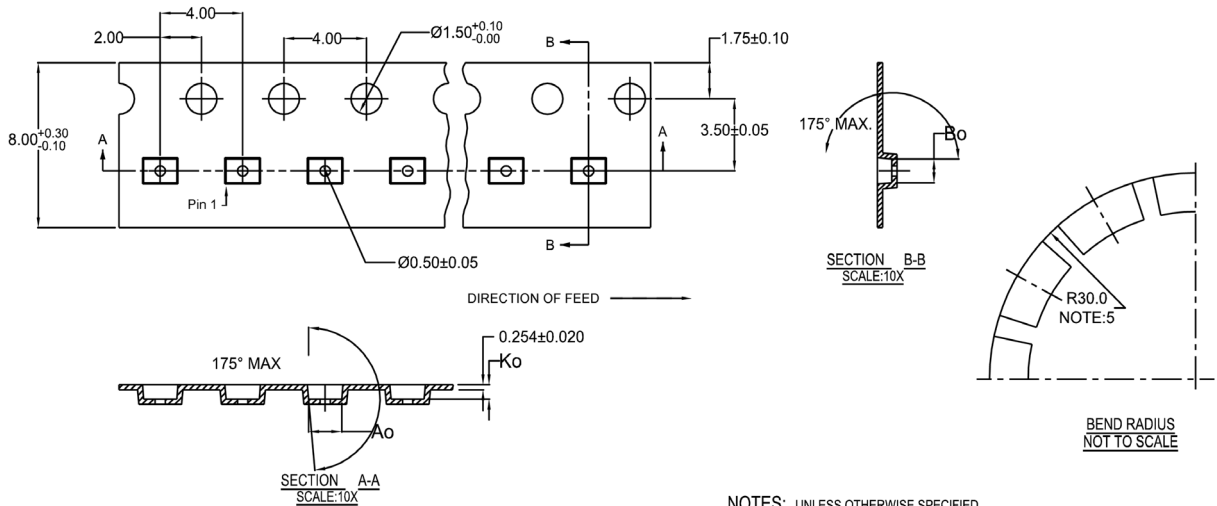
## Tape Specification

Tape Format for Micropak 10

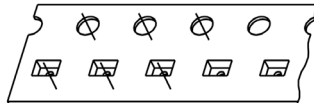
Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
L10X	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

## Tape Dimensions

Dimensions are in millimeters unless otherwise specified.



10	300056	2.30 $\pm$ 0.05	1.78 $\pm$ 0.05	0.68 $\pm$ 0.05
8	300038	1.78 $\pm$ 0.05	1.78 $\pm$ 0.05	0.68 $\pm$ 0.05
6	300033	1.60 $\pm$ 0.05	1.15 $\pm$ 0.05	0.70 $\pm$ 0.05



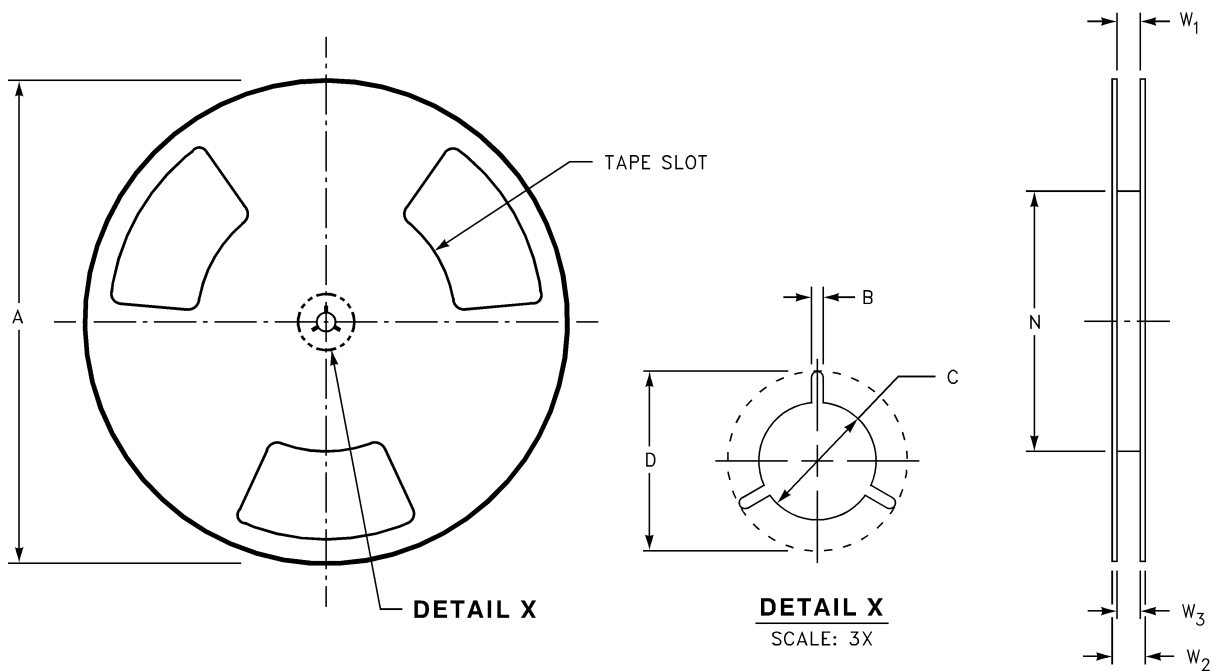
NOTES: UNLESS OTHERWISE SPECIFIED

- ACCUMULATED 50 SPROCKETS, SPROCKET HOLE PITCH IS 200.00 $\pm$ 0.30MM
- NO INDICATED CORNER RADIUS IS 0.127MM
- CAMBER NOT TO EXCEED 1MM IN 100MM
- SMALLEST ALLOWABLE BENDING RADIUS
- POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE



## Reel Dimensions

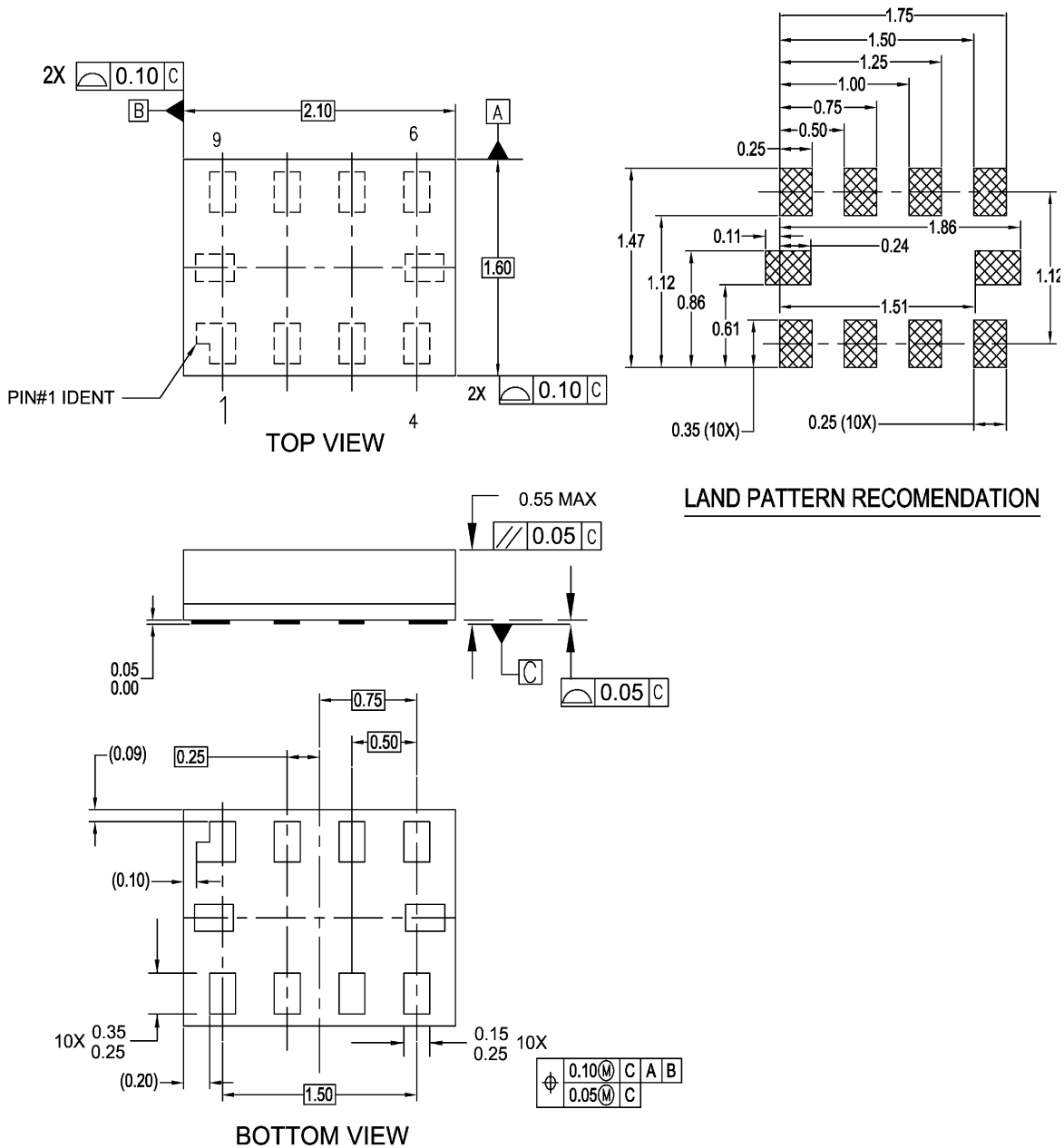
Dimensions are in inches (millimeters) unless otherwise noted.



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)

## Physical Dimensions

Dimensions are in inches (millimeters) unless otherwise noted.



**NOTES:**

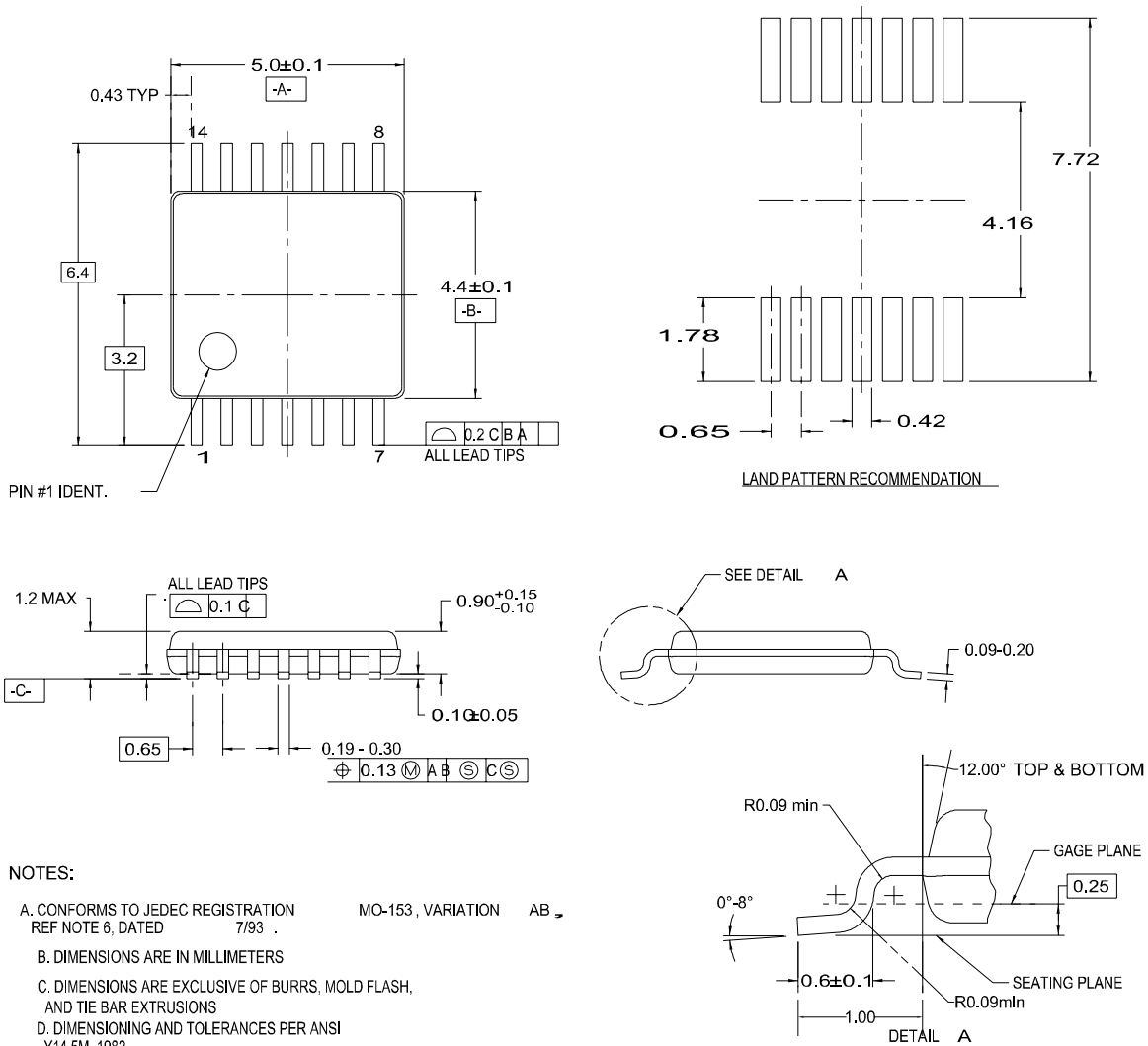
- A. PACKAGE CONFORMS TO JEDEC M0255, VARIATION UABD
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES CONFORMS TO ASME Y14.5M, 1994.

MAC010ARevC

Figure 9. Pb-Free 10-Lead MicroPak, 1.6 x 2.1mm

## Physical Dimension

Dimensions are in millimeters unless otherwise noted.



### NOTES:

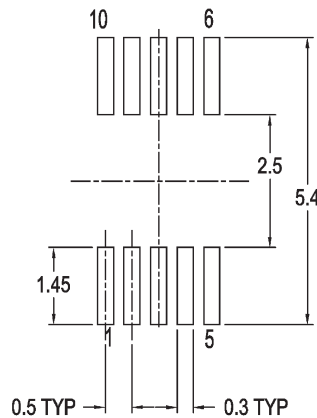
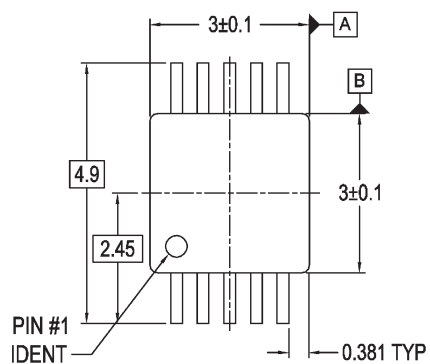
- A. CONFORMS TO JEDEC REGISTRATION REF NOTE 6, DATED 7/93 . MO-153, VARIATION AB
- B. DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982

MTC14revD

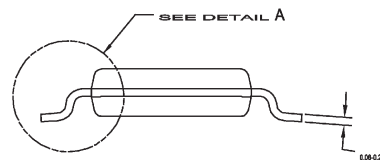
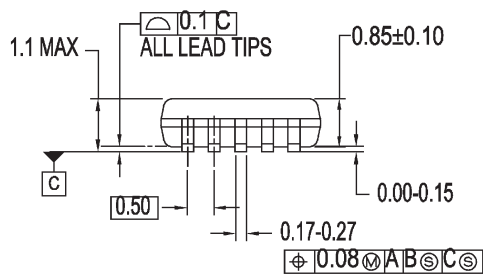
Figure 10. 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

## Physical Dimension

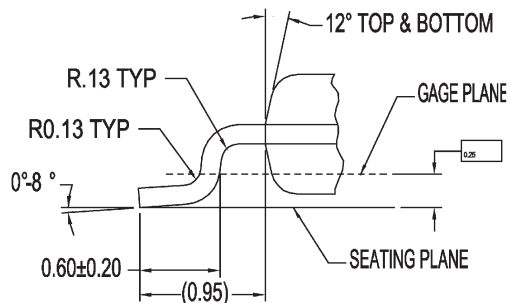
Dimensions are in millimeters unless otherwise noted.



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

**Figure 11. 10-Lead Molded Small Outline Package (MSOP), JEDEC MO-187, 3.0mm**

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Bottomless™	GTO™	OPTOLOGIC®	SPM™	VCX™
Build it Now™	HiSeC™	OPTOPLANAR™	Stealth™	Wire™
CoolFET™	I <sup>2</sup> C™	PACMAN™	SuperFET™	
CROSSVOLT™	i-Lo™	POP™	SuperSOT™-3	
DOME™	ImpliedDisconnect™	Power247™	SuperSOT™-6	
EcoSPARK™	IntelliMAX™	PowerEdge™	SuperSOT™-8	
E <sup>2</sup> CMOS™	ISOPLANAR™	PowerSaver™	SyncFET™	
EnSigna™	LittleFET™	PowerTrench®	TCM™	
FACT™	MICROCOUPLER™	QFET®	TinyBoost™	
FAST®	MicroFET™	QS™	TinyBuck™	
FAST <sub>r</sub> ™	MicroPak™	QT Optoelectronics™	TinyPWM™	
FPS™	MICROWIRE™	Quiet Series™	TinyPower™	
FRFET™	MSX™	RapidConfigure™	TinyLogic®	
	MSXPro™	RapidConnect™	TINYOPTO™	
Across the board. Around the world.™		μSerDes™	TruTranslation™	
The Power Franchise®		ScalarPump™	UHC™	
Programmable Active Droop™				

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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.
Preliminary	First Production	This datasheet contains preliminary data, and 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	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

Rev. 120