



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

FSUSB23 — High-Speed, USB2.0 (480Mbps) Switch

Features

- 10μA Maximum I_{CCT} Current over an Expanded Control
- Voltage Range: $V_{IN} = 2.6V$, $V_{CC} = 3.6V$
- Lower Capacitance: $C_{ON} = 9pF$ Typical
- 7Ω Typical On Resistance (R_{ON})
- -3dB Bandwidth: > 720MHz
- Low Power Consumption: 1mA Maximum
- Wide -3db Bandwidth: > 720MHz
- Packaged in:
 - 10-Lead MicroPak™ (1.6 x 2.1mm)
 - 16-Lead DQFN (2.5 x 3.5mm)
- 7kV I/O to GND ESD Performance

Description

The FSUSB23 is a low-power, high-bandwidth analog switch specifically designed for high speed USB 2.0 applications. The FSUSB23 features very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature services mobile handset applications, allowing direct interface with the baseband processor general-purpose I/Os.

Typical applications involve switching in portables and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers. The wide bandwidth (>720MHz) of this switch exceeds the bandwidth needed to pass the third harmonic, which results in signals with minimum edge and phase distortion. Superior channel-to-channel crosstalk results in minimal interference.

Applications

- Cell phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box

Ordering Information

Part Number	Top Mark	Operating Temperature Range	Package
FSUSB23L10X	EZ	-40 to +85°C	10-Lead MicroPak™ 1.6 x 2.1mm, JEDEC MO-255B
FSUSB23BQX	USB23	-40 to +85°C	16-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.5mm

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

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

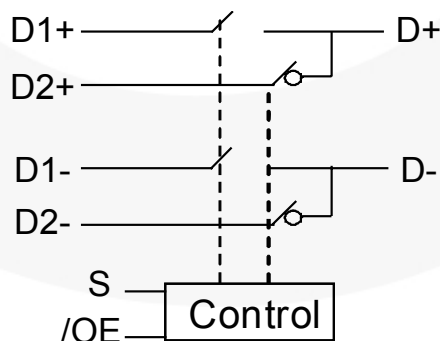


Figure 1. Analog Symbol

Pin Configurations

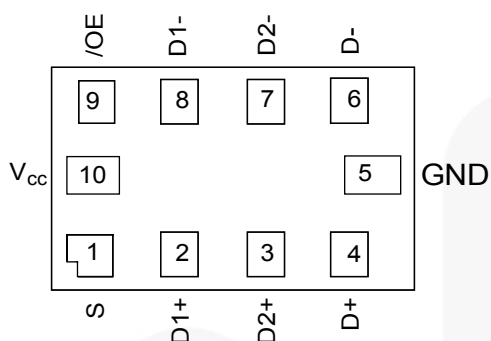


Figure 2. Pad Assignments for MicroPak™
(Top Through View)

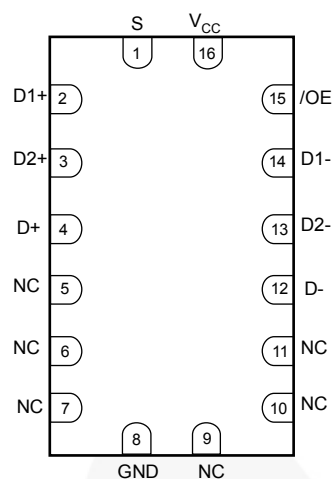


Figure 3. Pin Assignments for DQFN
(Top Through View)

Pin Definitions

Pin # Micropak	Pin # DQFN	Pin Name	Pin Description
1	1	S	Switch Select
9	15	/OE	Bus Switch Enable
2, 3, 4, 6, 7, 8	2, 3, 4, 12, 13, 14	D+, D-, Dn+, Dn-	Data Port
10	16	V _{CC}	Supply Voltage
5	8	GND	Ground
	5, 6, 7, 9, 10, 11	NC	No Connect

Truth Table

Sel	/OE	Function
X	HIGH	Disconnect
LOW	LOW	D+, D- = D1 _n
HIGH	LOW	D+, D- = D2 _n

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_{SW}	DC Switch Voltage ⁽¹⁾	-0.5	$V_{CC} + 0.5$	V
V_{IN}	DC Input Voltage ⁽¹⁾	-0.5	4.6	V
I_{IK}	DC Input Diode Current	-50		mA
I_{OUT}	DC Output Current		50	mA
T_{STG}	Storage Temperature	-65	+150	°C
ESD	Human Body Model, JEDEC: JESD22-A114	All Pins	7	kV
		I/O to GND	7	

Note:

1. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed. DC switch voltage may never exceed 4.6V.

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}	Supply Voltage		3.0	3.6	V
V _{CNTRL}	Control Input Voltage ⁽²⁾⁽³⁾		0	V _{CC}	V
V _{SW}	Switch Input Voltage		0	V _{CC}	V
T _A	Operating Temperature		-40	+85	°C
Θ _{JA}	Thermal Resistance	Micropak		250	°C/W

Note:

2. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed. DC switch voltage may never exceed 4.6V.
3. The control input must be held HIGH or LOW; it must not float.

DC Electrical Characteristics

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

Symbol	Parameter	Conditions	V _{CC} (V)	T _A =- 40°C to +85°C			Units
				Min.	Typ.	Max.	
V _{IK}	Clamp Diode Voltage	I _{IN} =-18mA	3.0			-1.2	V
V _{IH}	Input Voltage High		3.0 to 3.6	1.2			V
V _{IL}	Input Voltage Low		3.0 to 3.6			.50	V
I _{IN}	Control Input Leakage	V _{IN} =0V to V _{CC}	3.6			1	μA
I _{OZ}	Off State Leakage	0 ≤ D _n , D1 _n , D2 _n ≤ V _{CC}				1	μA
R _{ON}	Switch On Resistance ⁽⁴⁾	V _{SW} =0.4V, I _{ON} =-8mA	3.0		6	9	Ω
		V _{SW} =0.8V, I _{ON} =-8mA			7	10	
ΔR _{ON}	Delta R _{ON} ⁽⁵⁾	V _{IN} =0.4V, I _{ON} =-8mA	3.0		0.3		Ω
R _{ON Flat}	R _{ON} Flatness ⁽⁴⁾	V _{IN} =0V-1.0V, I _{ON} =-8mA	3.0		2.0		Ω
I _{CC}	Quiescent Supply Current	V _{IN} =0 or V _{CC} , I _{OUT} =0	3.6			1	μA
I _{CCT}	Increase in I _{CC} Current Per Control Voltage and V _{CC}	V _{IN} =2.6V V _{CC} =3.6V	3.6			10	μA

Notes:

- Measured by the voltage drop across the D_n, D1_n, D2_n pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (HSD_n or D_n ports).
- Guaranteed by characterization.

AC Electrical Characteristics

All typical values are for V_{CC}=3.3V at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V _{CC} (V)	T _A =- 40°C to +85°C			Units
				Min.	Typ.	Max.	
t _{ON}	Turn-On Time S, /OE to Output	V _{D1n} , D2 _n =0.8V, R _L =50Ω, C _L =10pF Figure 8	3.0 to 3.6		10	13	ns
t _{OFF}	Turn-Off Time S, /OE to Output	V _{D1n} , D2 _n =0.8V, R _L =50Ω, C _L =10pF Figure 8	3.0 to 3.6		8	11	ns
t _{PD}	Propagation Delay ⁽⁶⁾	R _L =50Ω, C _L =10pF Figure 6, Figure 7	3.3		0.25		ns
O _{IRR}	Off Isolation, Non-Adjacent	f=250MHz, R _T =50Ω Figure 14	3.0 to 3.6		-30		dB
Xtalk	Non-Adjacent Channel Crosstalk	f=250MHz, R _T =50Ω Figure 9	3.0 to 3.6		-43		dB
BW	-3db Bandwidth	R _T =50Ω Figure 13	3.0 to 3.6		720		MHz

Note:

- Guaranteed by characterization.

USB Hi-Speed-Related AC Electrical Characteristics

Symbol	Parameter	Conditions	V _{CC} (V)	T _A =- 40°C to +85°C			Units
				Min.	Typ.	Max.	
t _{SK(O)}	Channel-to-Channel Skew ⁽⁷⁾	R _L =50Ω, C _L =10pF Figure 6, Figure 12	3.0 to 3.6		40		ps
t _{SK(P)}	Skew of Opposite Transitions of the Same Output ⁽⁷⁾	R _L =50Ω, C _L =10pF Figure 6, Figure 12	3.0 to 3.6		20		ps
t _J	Total Jitter ⁽⁷⁾	R _L =50Ω, C _L =10pf, t _R =t _F =750ps at 480Mbps (PRBS=2 ¹⁵ - 1)	3.0 to 3.6		150		ps

Note:

7. Guaranteed by characterization.

Capacitance

Symbol	Parameter	Conditions	T _A =- 40°C to +85°C			Units
			Min.	Typ.	Max.	
C _{IN}	Control Pin Input Capacitance	V _{CC} =0V Figure 11		2		pF
C _{ON}	D1 _n , D2 _n , D _n On Capacitance	V _{CC} =3.3V, /OE=0V Figure 10		9		pF
C _{OFF}	D1 _n , D2 _n Off Capacitance	V _{CC} and /OE=3.3V Figure 11		4		pF

Test Diagrams

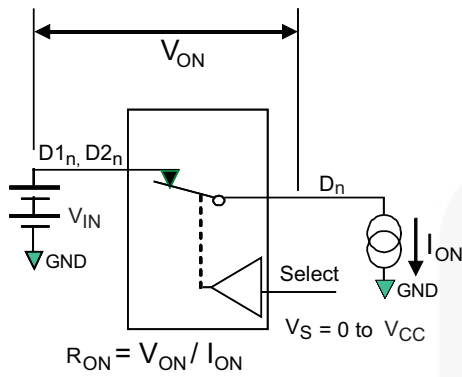
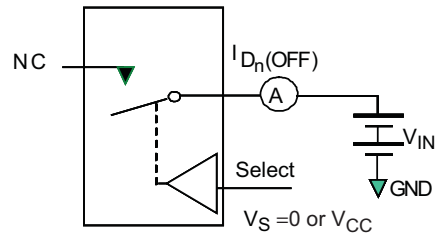
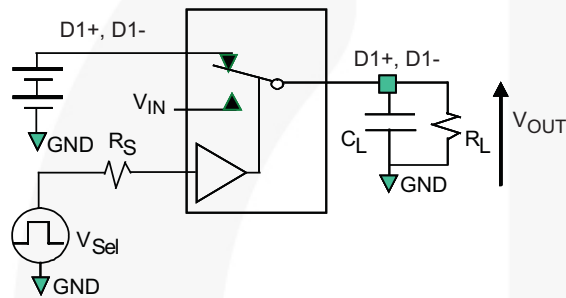


Figure 4. On Resistance



**Each switch port is tested separately

Figure 5. Off Leakage



R_L , R_S , and C_L are functions of the application environment (see AC Tables for specific values)
 C_L includes test fixture and stray capacitance.

Figure 6. AC Test Circuit Load

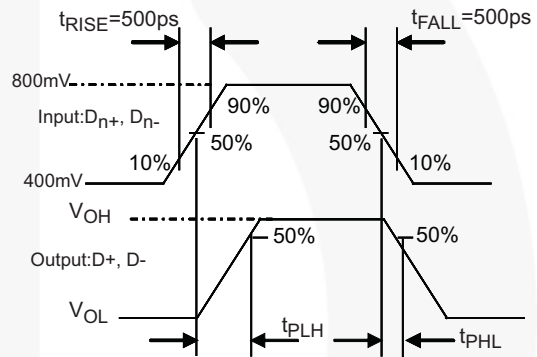


Figure 7. Switch Propagation Delay Waveforms

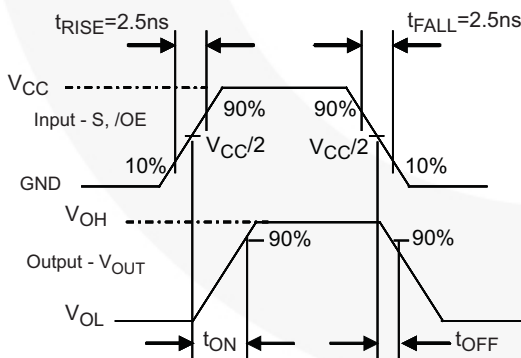
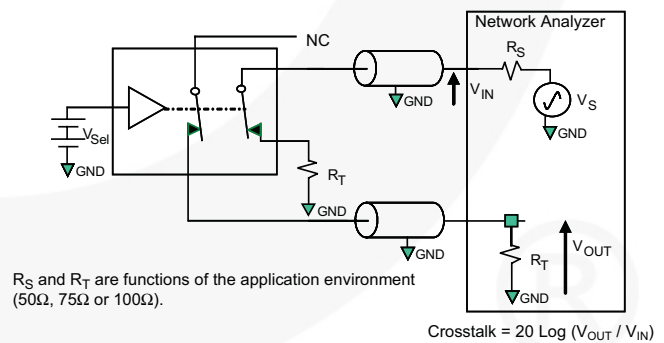


Figure 8. Turn On / Turn Off Waveform



R_S and R_T are functions of the application environment
 (50Ω, 75Ω or 100Ω).

Figure 9. Non-Adjacent Channel-to-Channel Crosstalk

Test Diagrams (Continued)

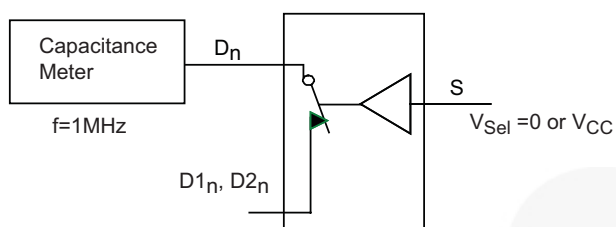


Figure 10. Channel On Capacitance

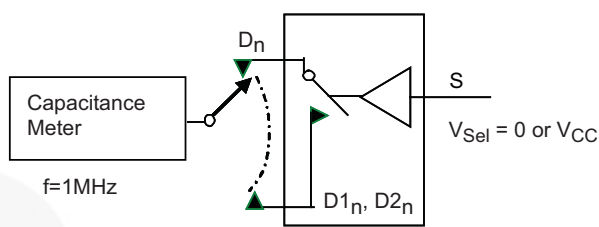


Figure 11. Channel Off Capacitance

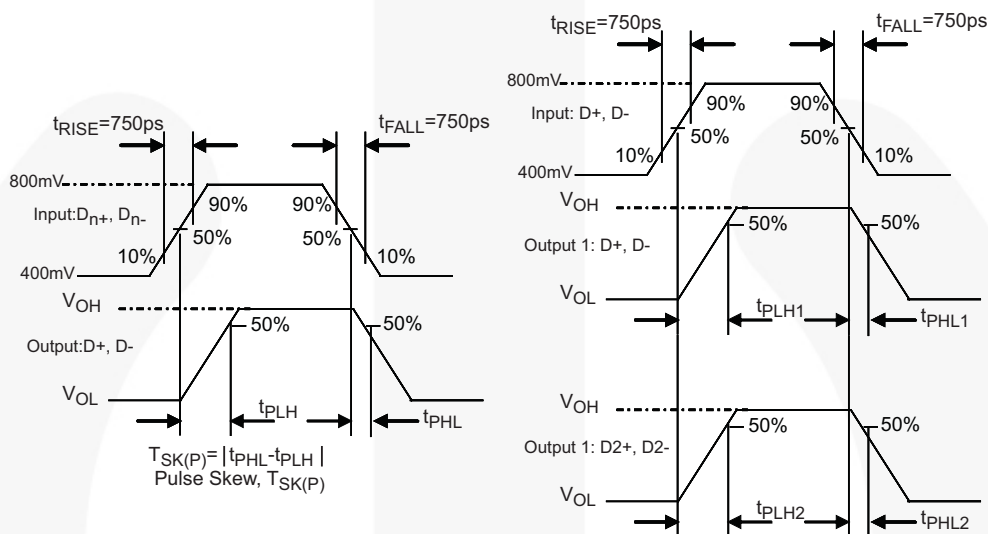


Figure 12. Switch Skew Tests

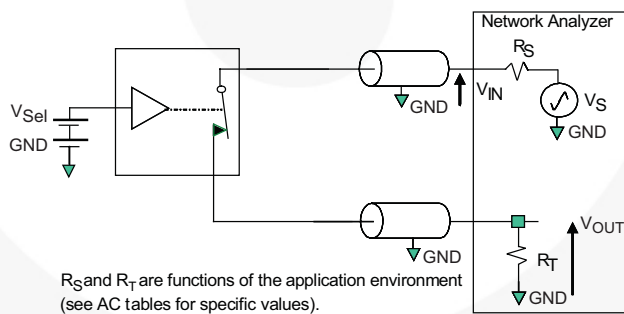


Figure 13. Bandwidth

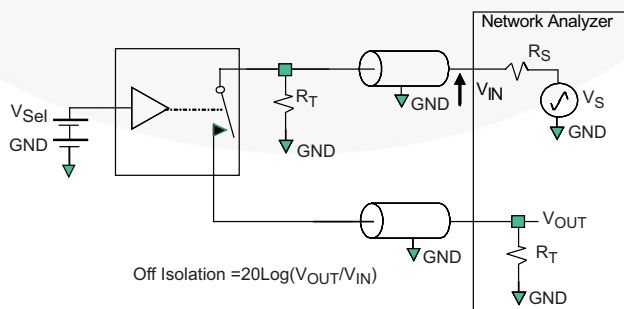
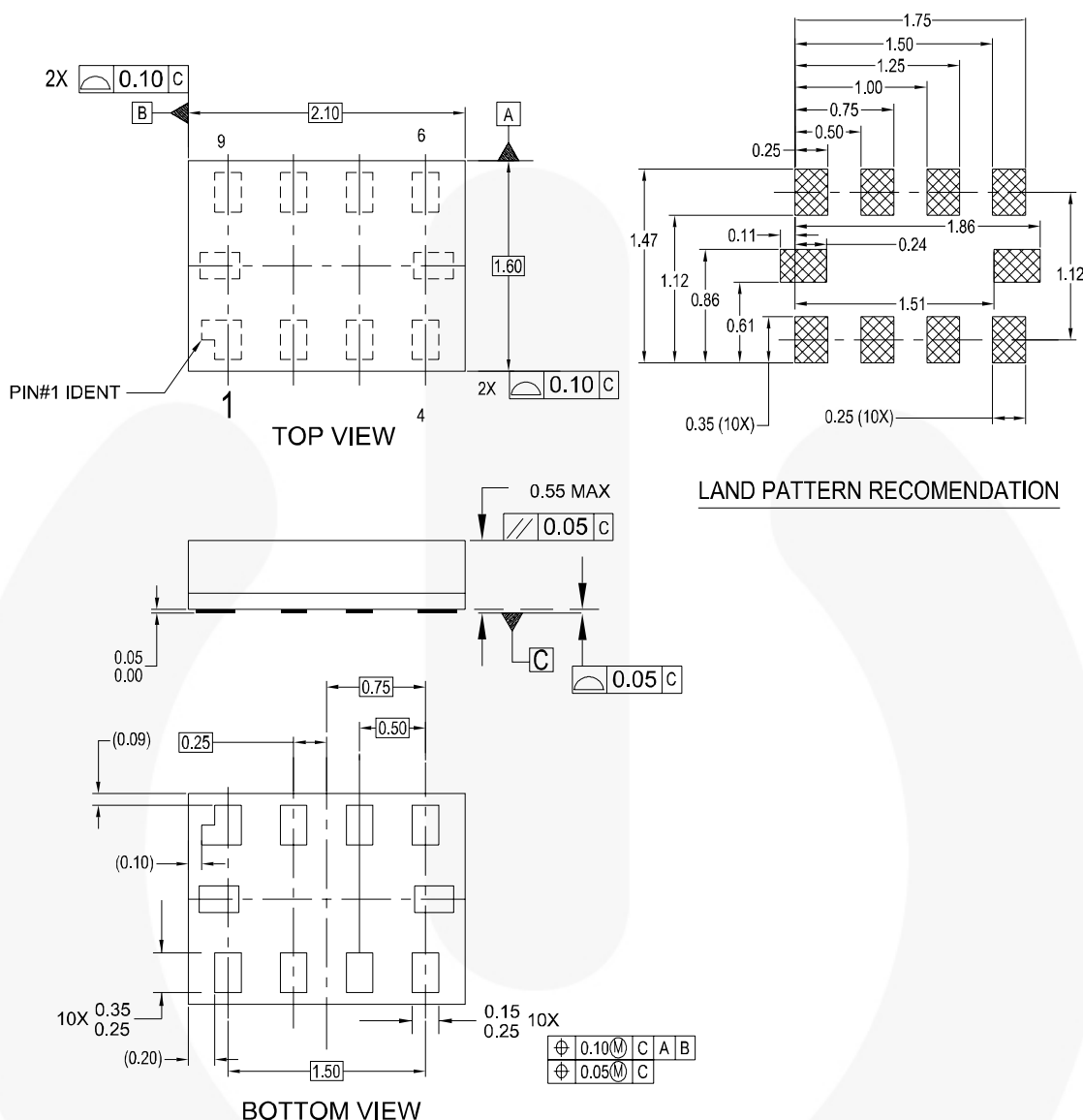


Figure 14. Channel Off Isolation



NOTES:

- A. PACKAGE CONFORMS TO JEDEC MO255, VARIATION UABD
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES CONFORMS TO ASME Y14.5M, 1994.

MAC010ARevC

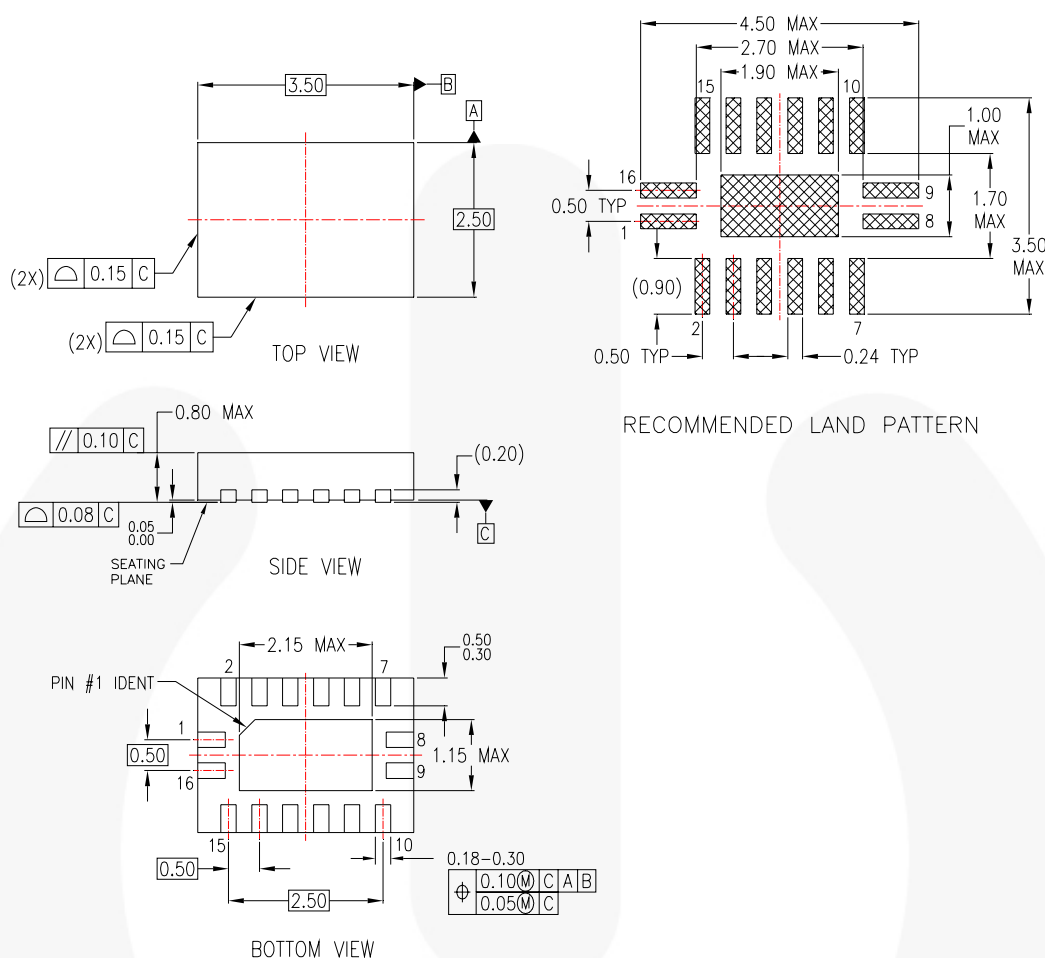
Figure 15. 10-Lead MicroPak™ 1.6 x 2.1mm

Note: click here for tape and reel specifications, available at:
http://www.fairchildsemi.com/products/analog/pdf//micropak_tr.pdf

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:
<http://www.fairchildsemi.com/packaging/>

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 16. 16-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN) Package

Note: [click here for tape and reel specifications, available at:](http://www.fairchildsemi.com/products/analog/package/MLP16_25x35.html)
http://www.fairchildsemi.com/products/analog/package/MLP16_25x35.html

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:
<http://www.fairchildsemi.com/package/>



TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

ACEX [®]	FPST [™]	PDP SPM [™]	The Power Franchise [®]
Build it Now [™]	F-PFS [™]	Power-SPM [™]	the power franchise
CorePLUS [™]	FRFET [®]	PowerTrench [®]	TinyBoost [™]
CorePOWER [™]	Global Power Resource SM	Programmable Active Droop [™]	TinyBuck [™]
CROSSVOLT [™]	Green FPST [™]	QFET [®]	TinyLogic [®]
CTL [™]	Green FPST [™] e-Series [™]	QS [™]	TINYOPTO [™]
Current Transfer Logic [™]	GTO [™]	Quiet Series [™]	TinyPower [™]
EcoSPARK [®]	IntelliMAX [™]	RapidConfigure [™]	TinyPWM [™]
EfficientMax [™]	ISOPLANAR [™]	Saving our world, 1mW at a time [™]	TinyWire [™]
EZSWITCH [™] *	MegaBuck [™]	SmartMax [™]	μSerDes [™]
EZ [™]	MICROCOUPLER [™]	SMART START [™]	μSerDes
F [®]	MicroFET [™]	SPM [®]	UHC [®]
Fairchild [®]	MicroPak [™]	STEALTH [™]	Ultra FRFET [™]
Fairchild Semiconductor [®]	MillerDrive [™]	SuperFET [™]	UniFET [™]
FACT Quiet Series [™]	MotionMax [™]	SuperSOT [™] -3	V CX [™]
FACT [®]	Motion-SPM [™]	SuperSOT [™] -6	VisualMax [™]
FAST [®]	OPTOLOGIC [®]	SuperSOT [™] -8	
FastvCore [™]	OPTOPLANAR [®]	SupreMOS [™]	
FlashWriter [®] *		SyncFET [™]	
		SYSTEM GENERAL	

* EZSWITCH[™] and FlashWriter[®] are trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in 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 / 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; 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 the design.
Obsolete	Not In Production	This datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I34

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada

Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local
Sales Representative