



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.



FSUSB43 — Low-Power, Two-Port, High-Speed, USB2.0 (480Mbps) Switch

Features

- Over-Voltage Tolerance (OVT) on all USB Ports up to 5.25V without External Components
- Low On Capacitance: 3.7pF Typical
- Low On Resistance: 3.9Ω Typical
- Low Power Consumption: 1μA Maximum
 - 20μA Maximum I_{CCT} over an Expanded Voltage Range ($V_{IN}=1.8V$, $V_{CC}=4.3V$)
- Wide -3db Bandwidth: > 720MHz
- Packaged in 10-Lead MicroPak™ (1.6 x 2.1mm)
- 8kV ESD Rating, >16kV Power/GND ESD Rating
- Power-Off Protection on All Ports when $V_{CC}=0V$
 - D+/D- Pins Tolerate up to 5.25V

Applications

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

IMPORTANT NOTE:

For additional performance information, please contact analogswitch@fairchildsemi.com.

Description

The FSUSB43 is a bi-directional, low-power, two-port, high-speed, USB2.0 switch. Configured as a double-pole, double-throw (DPDT) switch, it is optimized for switching between two high-speed (480Mbps) sources or a high-speed and full-speed (12Mbps) source.

The FSUSB43 is compatible with the requirements of USB2.0 and features an extremely low on capacitance (C_{ON}) of 3.7pF. The wide bandwidth of this device (720MHz) exceeds the bandwidth needed to pass the third harmonic, resulting in signals with minimum edge and phase distortion. Superior channel-to-channel crosstalk also minimizes interference.

The FSUSB43 contains special circuitry on the switch I/O pins for applications where the V_{CC} supply is powered-off ($V_{CC}=0$), which allows the device to withstand an over-voltage condition. This minimizes current consumption even when the control voltage applied to the SEL pin is lower than the supply voltage (V_{CC}). This feature is especially valuable to mobile applications, such as cell phones, allowing for direct interface with the general-purpose I/Os of the baseband processor. Other applications include switching and connector sharing in portable cell phones, PDAs, digital cameras, printers, and notebook computers.

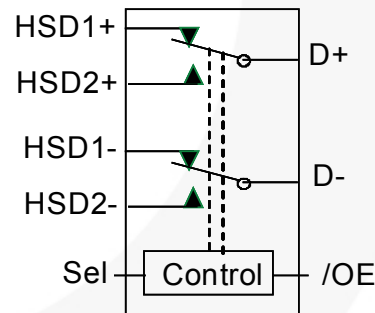


Figure 1. Analog Symbol

Ordering Information

Part Number	Top Mark	Operating Temperature Range	Eco Status	Package
FSUSB43L10X	JH	-40 to +85°C	Green	10-Lead MicroPak™ 1.6 x 2.1mm, JEDEC MO-255B

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Pin Configuration

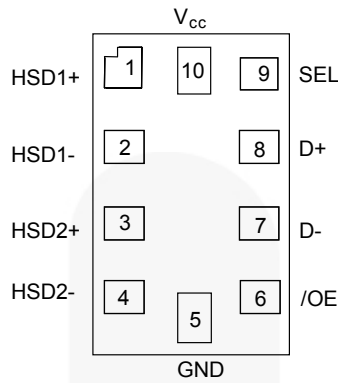


Figure 2. Pin Assignment (Top Through View)

Pin Definitions

Pin #	Name	Description
1	HSD1+	Multiplexed Source Inputs
2	HSD1-	Multiplexed Source Inputs
3	HSD2+	Multiplexed Source Inputs
4	HSD2-	Multiplexed Source Inputs
5	GND	Ground
6	/OE	Switch Enable
7	D-	USB Data Bus
8	D+	USB Data Bus
9	SEL	Switch Select
10	V _{cc}	Supply Voltage

Truth Table

SEL	/OE	Function
X	HIGH	Disconnect
LOW	LOW	D+, D-=HSD1+, HSD1-
HIGH	LOW	D+, D-=HSD2+, HSD2-

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	+5.5	V	
V _{CNTRL}	DC Input Voltage (Sel, /OE) ⁽¹⁾	-0.5	V _{CC}	V	
V _{SW}	ALL PINS for V _{CC} 0 to 5.5V	-0.5	5.5	V	
I _{IK}	DC Input Diode Current	-50		mA	
I _{OUT}	DC Output Current		100	mA	
T _{STG}	Storage Temperature	-65	+150	°C	
ESD	Human Body Model: JEDEC JESD22-A114	All Pins		8	kV
		I/O to GND		9	
		Power to GND		16	
	Charged Device Model: JEDEC JESD22-C101			2	

Note:

- The input and output negative 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}	Supply Voltage	3.0	4.3	V
V _{CNTRL}	Control Input Voltage ⁽²⁾ (Sel, /OE)	0	V _{CC}	V
V _{SW}	Switch I/O Voltage	-0.5	4.5	V
T _A	Operating Temperature	-40	+85	°C

Note:

- 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	1.3			V
			4.3	1.7			V
V _{IL}	Input Voltage Low		3.0 to 3.6			0.5	V
			4.3			0.7	V
I _{IN}	Control Input Leakage	V _{SW} =0 to V _{CC}	4.3	-1.0		1.0	μA
I _{OZ}	Off State Leakage	0 ≤ D _n , HSD1n, HSD2n ≤ 3.6V	4.3	-2.0		2.0	μA
I _{OFF}	Power-Off Leakage Current (All I/O Ports)	V _{SW} =0V to 4.3V, V _{CC} =0V Figure 4	0	-2		2	μA
R _{ON}	HS Switch On Resistance ⁽³⁾	V _{SW} =0.4V, I _{ON} =-8mA Figure 3	3.0		3.9	6.5	Ω
ΔR _{ON}	HS Delta R _{ON} ⁽⁴⁾	V _{SW} =0.4V, I _{ON} =-8mA	3.0		0.65		Ω
I _Q	Quiescent Supply Current	V _{CNTRL} =0 or V _{CC} , I _{OUT} =0	4.3			1.0	μA
I _{CCT}	Increase in I _Q Current per Control Voltage and V _{CC}	V _{CNTRL} =2.6V, V _{CC} =4.3V	4.3			10.0	μA
		V _{CNTRL} =1.8V, V _{CC} =4.3V	4.3			20.0	μA

Notes:

3. Measured by the voltage drop between HSDn and Dn pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (HSDn or Dn ports).
4. Guaranteed by characterization.

AC Electrical Characteristics

All typical values are for $V_{CC}=3.3V$ at $25^{\circ}C$ unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A=-40^{\circ}C$ to $+85^{\circ}C$			Units
				Min.	Typ.	Max.	
t_{ON}	Turn-On Time SEL, /OE to Output	$R_L=50\Omega$, $C_L=5pF$, $V_{SW}=0.8V$ Figure 5, Figure 6	3.0 to 3.6		13	30	ns
t_{OFF}	Turn-Off Time SEL, /OE to Output	$R_L=50\Omega$, $C_L=5pF$, $V_{SW}=0.8V$ Figure 5, Figure 6	3.0 to 3.6		12	25	ns
t_{PD}	Propagation Delay ⁽⁵⁾	$R_L=50\Omega$, $C_L=5pF$ Figure 5, Figure 7	3.3		0.25		ns
t_{BBM}	Break-Before-Make Time ⁽⁵⁾	$R_L=50\Omega$, $C_L=5pF$ $V_{SW1}=V_{SW2}=0.8V$ Figure 9	3.0 to 3.6	2.0		6.5	ns
OIRR	Off Isolation ⁽⁵⁾	$R_L=50\Omega$, $f=240MHz$ Figure 11	3.0 to 3.6		-30		dB
Xtalk	Non-Adjacent Channel Crosstalk ⁽⁵⁾	$R_L=50\Omega$, $f=240MHz$ Figure 12	3.0 to 3.6		-45		dB
BW	-3db Bandwidth ⁽⁵⁾	$R_L=50\Omega$, $C_L=0pF$ Figure 10	3.0 to 3.6		720		MHz
		$R_L=50\Omega$, $C_L=5pF$ Figure 10			550		MHz

Note:

5. Guaranteed by characterization.

USB High-Speed-Related AC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A=-40^{\circ}C$ to $+85^{\circ}C$			Units
				Min.	Typ.	Max.	
$t_{SK(P)}$	Skew of Opposite Transitions of the Same Output ⁽⁶⁾	$R_L=50\Omega$, $C_L=5pF$ Figure 8	3.0 to 3.6		20		ps
t_J	Total Jitter ⁽⁶⁾	$R_L=50\Omega$, $C_L=5pF$, $t_r=t_f=500ps$ (10-90%) at 480Mbps, (PRBS= $2^{15}-1$)	3.0 to 3.6		200		ps

Note:

6. Guaranteed by characterization.

Capacitance

Symbol	Parameter	Conditions	$T_A=-40^{\circ}C$ to $+85^{\circ}C$			Units
			Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance ⁽⁷⁾	$V_{CC}=0V$		1.5		pF
C_{ON}	D+/D- On Capacitance ⁽⁷⁾	$V_{CC}=3.3V$, /OE=0V, $f=240MHz$ Figure 14		3.7		
C_{OFF}	D1n, D2n Off Capacitance ⁽⁷⁾	V_{CC} and /OE=3.3V Figure 13		2.0		

Note:

7. Guaranteed by characterization.

Test Diagrams

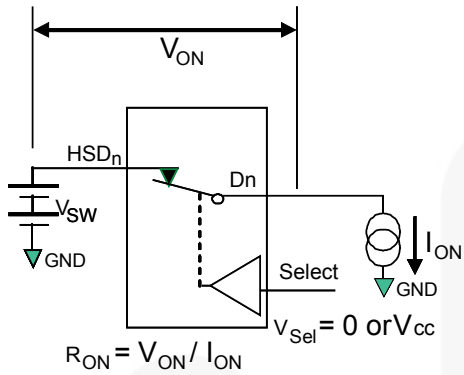
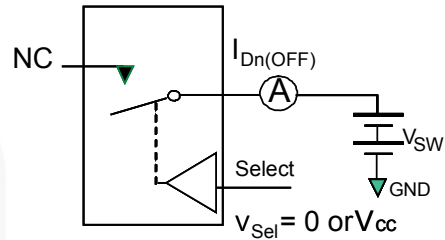
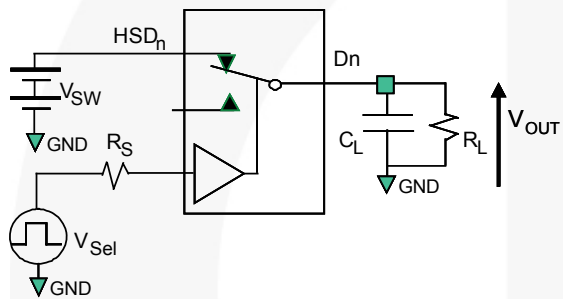


Figure 3. On Resistance



**Each switch port is tested separately

Figure 4. 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 5. AC Test Circuit Load

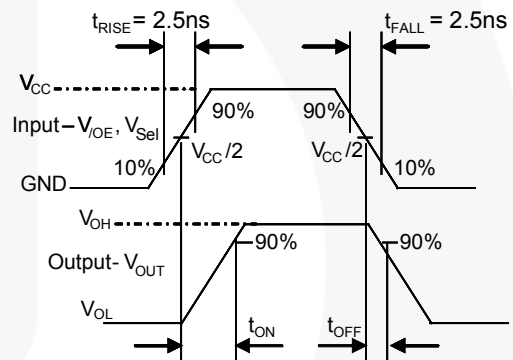


Figure 6. Turn-On / Turn-Off Waveforms

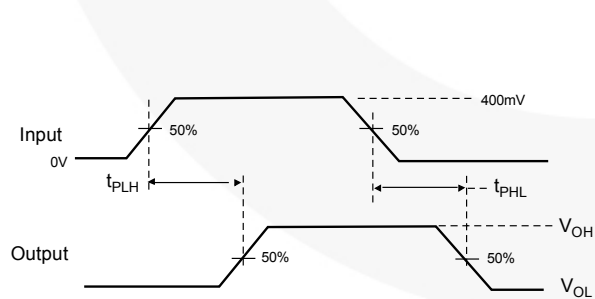


Figure 7. Propagation Delay ($t_{tr} = 500ps$)

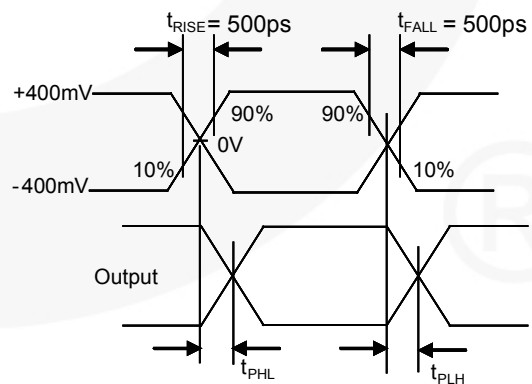
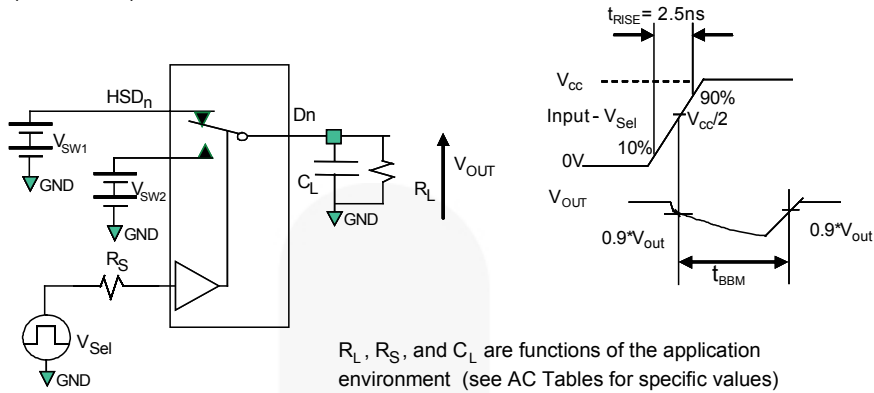


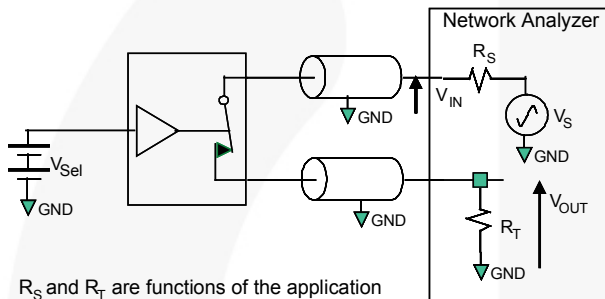
Figure 8. Intra-Pair Skew Test $t_{SK(P)}$

Test Diagrams (Continued)



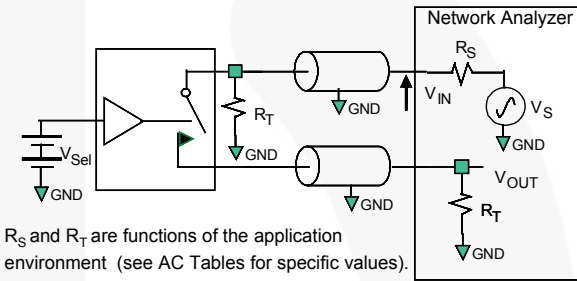
R_L , R_S , and C_L are functions of the application environment (see AC Tables for specific values)
 C_L includes test fixture and stray capacitance.

Figure 9. Break-Before-Make Interval Timing



R_S and R_T are functions of the application environment (see AC Tables for specific values).

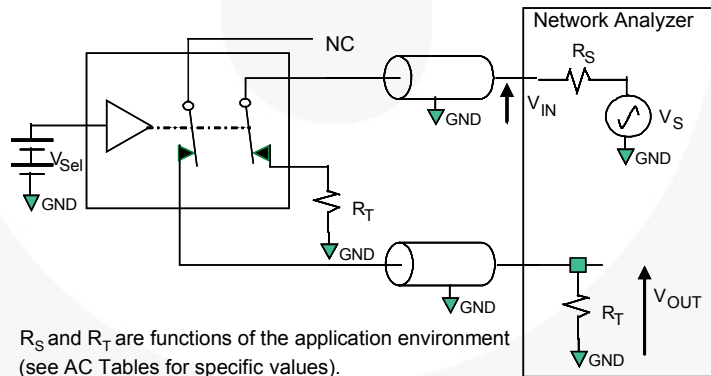
Figure 10. Bandwidth



R_S and R_T are functions of the application environment (see AC Tables for specific values).

Off isolation = $20 \text{ Log } (V_{OUT} / V_{IN})$

Figure 11. Channel Off Isolation



R_S and R_T are functions of the application environment (see AC Tables for specific values).

Crosstalk = $20 \text{ Log } (V_{OUT} / V_{IN})$

Figure 12. Non-Adjacent Channel-to-Channel Crosstalk

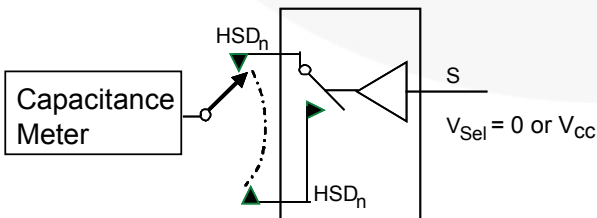


Figure 13. Channel Off Capacitance

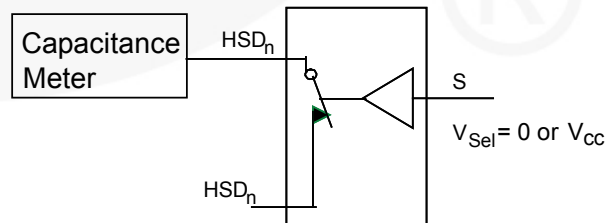
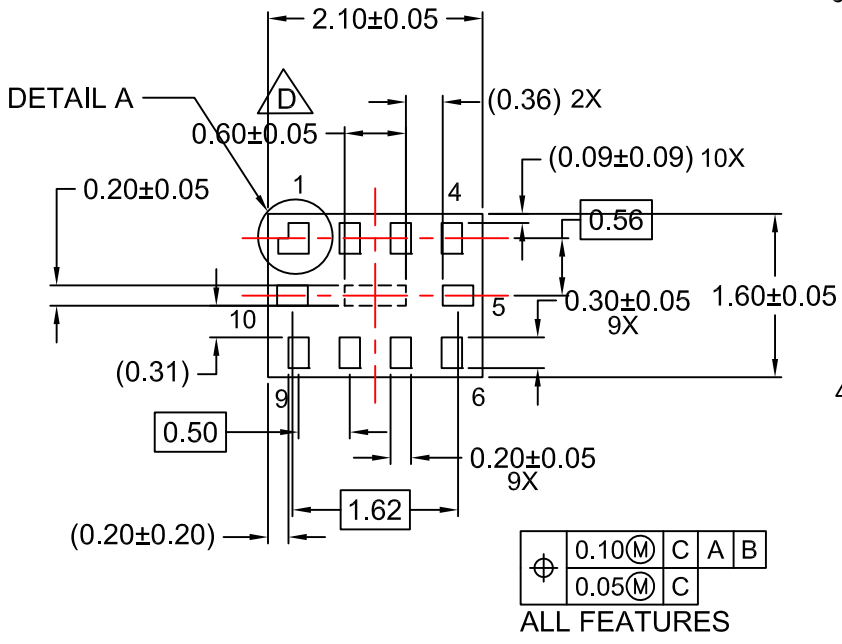
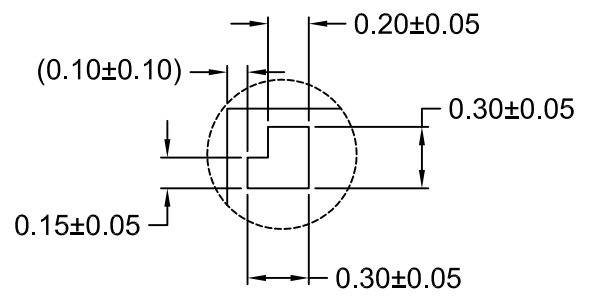
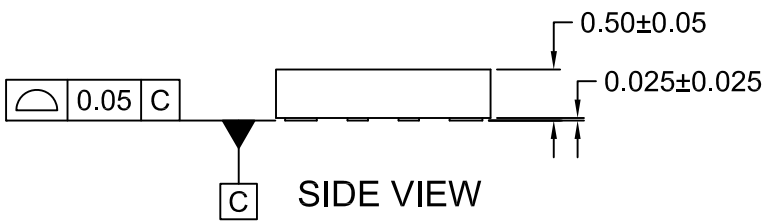
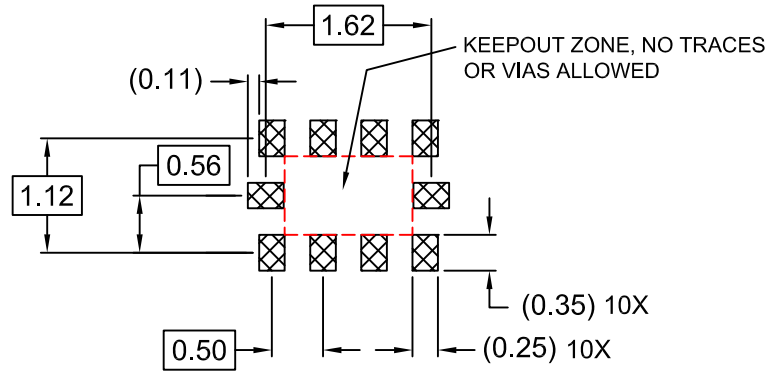
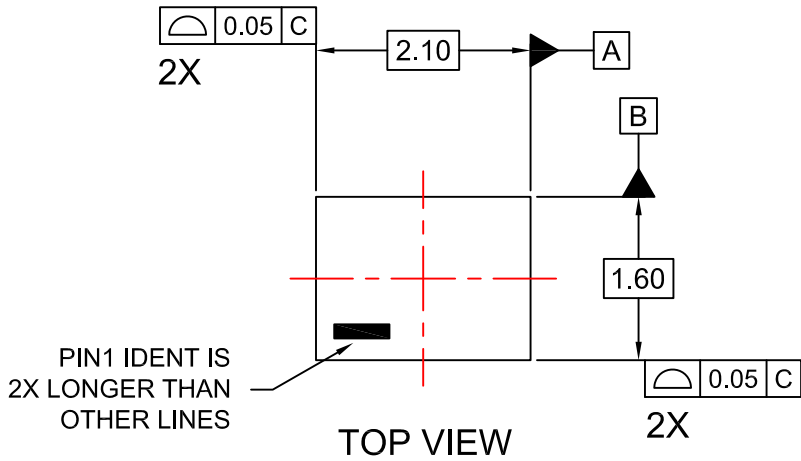


Figure 14. Channel On Capacitance



- NOTES:
- A. PACKAGE CONFORMS TO JEDEC REGISTRATION MO-255, VARIATION UABD .
 - B. DIMENSIONS ARE IN MILLIMETERS.
 - C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
 - 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-MAC10Arev6.
 - F. DIMENSIONS WITHIN () ARE UNCONTROLLED



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