RoHS Compliant
HALOGEN-FREE

MagnaChip

MSI2001

USB2.0 High-Speed (480Mbps) Analog Switch

General Description

The MSI2001 is a dual-pole double-throw (DPDT) analog device aimed for fast signals switching applications of portable electrical devices. It is especially designed for high-speed (HS) USB2.0 (480Mb/s) applications including low- and full-speed USB signaling in mobile phones.

The MSI2001 features low on-channel resistance with low on-channel capacitance allowing little attenuation and distortion during bi-directional HS signal routing. High crosstalk and off-isolation result in minimum noise interference with good signal integrity. Also the device features the wide bandwidth and very low current consumption resulting high performance in HS signal switching applications.

The MSI2001 is available in Halogen-Free, RoHS compliant 10 pins, ultra small QFN & MSOP and can operate over -40°C to +85°C ambient temperature range. For more detailed information, please contact your local MagnaChip sales office in world-wide or visit MagnaChip's website at *www.magnachip.com*.

Features

- ±8kV Human Body Model (HBM) ESD protection on all pins
- Low C_{ON} : 7pF (Typ) @ 3.6V_{DD}
- Low R_{ON} : 4.0Ω (Typ) @ 3.0V_{DD}
- -3dB bandwidth : 720MHz (Typ)
- Low supply current in standby mode (<1μA) and under wide control voltage range (6μA @ 2.6V_{DD})
- High crosstalk : -45dB (Typ)
- Power-Off protection (V_{DD}=0V) and Power-On protection (V_{DD}≠0V) on D+ & D- tolerate up to 5.25V
- V_{DD}+0.3V signals can be handled under V_{DD} supply voltage condition
- Halogen-free 10 leads QFN package & MSOP package

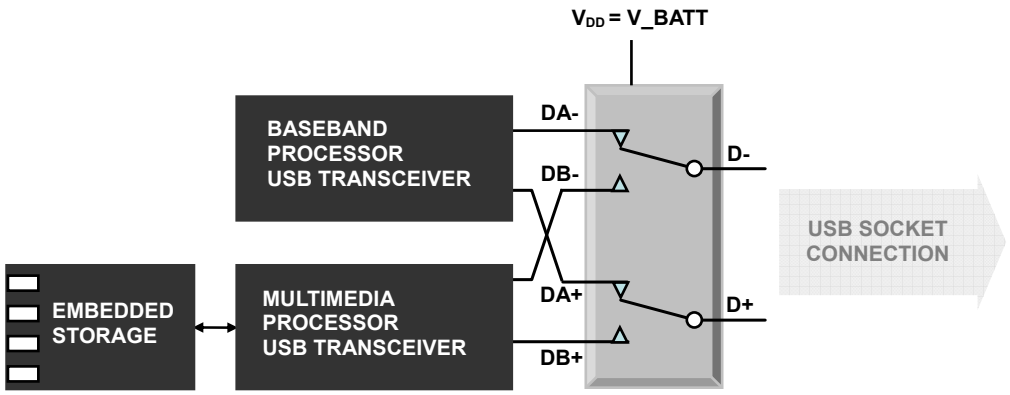
Applications

- USB2.0 Switching
- HS differential signals applications
- Portable devices (Cell phone, PDAs, Notebook Computers)

Ordering Information

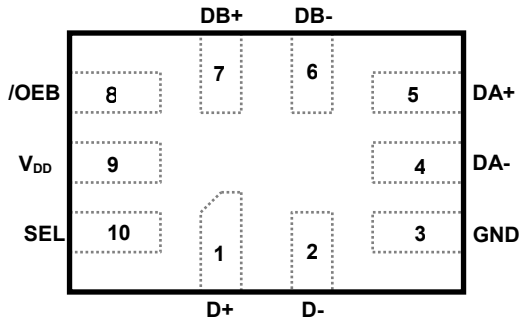
Part Number	Top Marking	Ambient Temperature Range	Package [mm]	RoHS Status
MSI2001QH	S1U	-40℃ to +85℃	1.4mm x 1.8mm x 0.5mm, 10 leads QFN	Halogen-Free
MSI2001MH	S2U		3.0mm x 4.9 mm 1.1 mm, 10 leads MSOP	

Typical Application

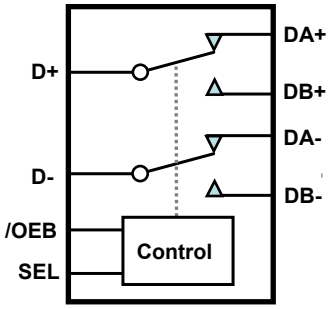


Pin Configuration

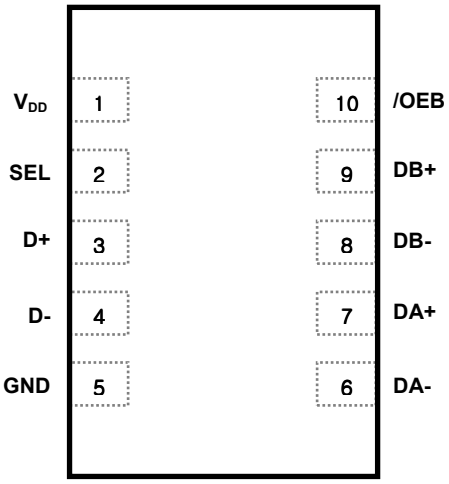
10 pins QFN Package (Top View)



Block Diagram



10 pins MSOP (Top View)



Pin Description

Pin Assignment	Description
/OEB	Output Enable Bar (Active Low)
SEL	Select A/B Control
D+, D-	Common Data Ports
DA+/-, DB+/-	A/B Data Ports
VDD	DC Supply voltage Input Pin
GND	Ground Pin

Truth Table

SEL	OEB	Function
X	H	Disconnect
L	L	Select A port (D+/- =DA+/-)
H	L	Select B port (D+/-=DB+/-)

Absolute Maximum Ratings (Note 1)

Symbol	Parameter		Min	Max	Unit
V_{DD}	DC Supply Voltage on VDD pin		-0.5	4.6	V
V_{SEL}	Control Input Voltage		-0.5	4.6	V
$V_{IN/OUT}$	Input Voltage in D*, DA/B*	DA/B+, DA/B-	-0.5	V_{DD}+0.3	V
		D+,D- when V_{DD} > 0	-0.5	V_{DD}+0.3	V
		D+,D- when V_{DD} = 0	-0.5	5.25	V
$I_{IN/OUT}$	In/Out Current in D*, DA/B*			50	mA
ESD	HBM (Note 2)			8000	V
	MM (Note 3)			400	
	CDM (Note 4)			1500	
T_S	Storage Temperature		-65	+150	°C

Note 1: Stresses beyond the above listed maximum ratings may damage the device permanently. Operating above the recommended conditions for extended time may stress the device and affect device reliability. Also the device may not operate normally above the recommended operating conditions. These are stress ratings only.
Note 2: ESD tested per JESD22A-114E.
Note 3: ESD tested per JESD22A-115.
Note 4: ESD tested per JESD22C-101.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{DD}	Supply Voltage	3	4.3	V
V_{SEL}	Control Input Voltage (Note 1)	0	V_{DD}	V
$V_{IN/OUT}$	Input Voltage in D*, DA/B*	0	V_{DD}	V
T_A	Operating Temperature	-40	+85	°C

Note1: Control pin input must be held “HIGH” or “LOW” and it must not float during operation.

DC Electrical Characteristics

All listed typical values are at 25°C unless otherwise specified. **Boldface** values indicate -40°C to +125°C of T_J.

Symbol	Parameter	Test Conditions	V_{DD}(V)	Min	Typ	Max	Unit
V_{SEL_H}	Control Input High Voltage	3 ≤ V_{DD} ≤ 3.6V	3.0 ~ 3.6	**1.3**			V
		V_{DD} = 4.3V	4.3	**1.7**			V
V_{SEL_L}	Control Input Low Voltage	3 ≤ V_{DD} ≤ 3.6V	3.0 ~ 3.6			**0.5**	V
		V_{DD} = 4.3V	4.3			**0.7**	V
I_{SEL}	Control Input Leakage Current	0 < V_{SEL} ≤ V_{DD}	4.3	**-1**		**1**	μA
I_{CC}	Quiescent Supply Current	V_{SEL} = 0 or V_{DD}, $I_{IN/OUT}$ = 0A	4.3			**1**	μA
I_{CCT}	Increase in I_{CC} on V_{DD} pin per Control Voltage	V_{SEL} = 2.6V	4.3			**6**	μA
I_{LEAK}	OFF State Leakage Current on D±, DA±, DB±	0 < $V_{D±, DA±, DB±}$ ≤ 3.6V	4.3	**-2**		**2**	μA
I_{OFF}	Power OFF Leakage Current on D± (See Figure 1)	$V_{D+,D-}$ = 4.3V	0	**-2**		**2**	μA
R_{ON}	On-Resistance (See Figure 2)	$V_{IN/OUT}$ = 0.4V, $I_{IN/OUT}$ = 8mA	3.0		4	**6.5**	Ω
△ R_{ON}	On-Resistance Match Between Channels (Note 1)	$V_{IN/OUT}$ = 0.4V, $I_{IN/OUT}$ = 8mA	3.0		0.35		Ω
R_{FLAT_ON}	R_{ON} Flatness (Note 2)	0 < $V_{IN/OUT}$ ≤ 1.0V, $I_{IN/OUT}$ = 8mA	3.0		1		Ω

Note 1: △$R_{ON(MAX)}$ = | R_{ON}(Channel1)-R_{ON}(Channel2) |
Note 2: R_{FLAT_ON} is defined as the difference between the maximum and minimum value of R_{ON} measured over specified $V_{IN/OUT}$ range.

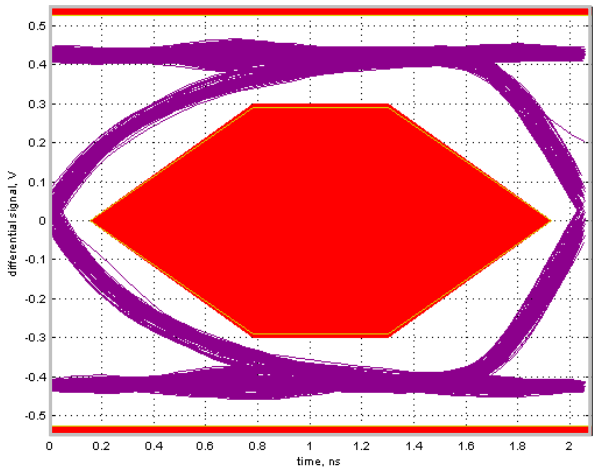
AC Electrical Characteristics (Note 1)

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

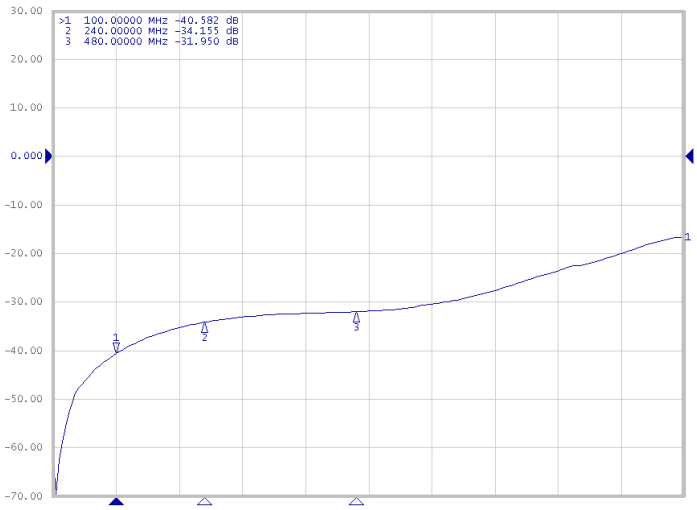
Symbol	Parameter	Test Conditions	V_{DD}(V)	Min	Typ	Max	Unit
Time & Frequency							
t_{ON}	Turn-On Time (See Figure 3)	$V_{IN/OUT}$ = 0.8V, R_L = 50Ω, C_L = 5pF, V_{SEL_H} = V_{DD}, V_{SEL_L} = 0	3.0 ~ 3.6		13	30	ns
t_{OFF}	Turn-Off Time	$V_{IN/OUT}$ = 0.8V, R_L = 50Ω, C_L = 5pF, V_{SEL_H} = V_{DD}, V_{SEL_L} = 0	3.0 ~ 3.6		12	25	ns
t_{PD_RISE} t_{PD_FALL}	Rise/Fall Propagation Delay (See Figure 4)	R_L = R_S = 50Ω, C_L = 5pF	3.3		0.25		ns
t_{BBM}	Break-Before-Make Delay Time (See Figure 5)	R_L = R_S = 50Ω, C_L = 5pF	3.0 ~ 3.6		5		ns
$t_{SK(O)}$	Output Skew between Switches (See Figure 4)	Skew between Switch 1 and Switch 2 R_L = R_S = 50Ω, C_L = 5pF	3.0 ~ 3.6		0.05		ns
$t_{SK(P)}$	Output Skew of same Switch (See Figure 4)	Skew between Opposite Transitions in Same Switch	3.0 ~ 3.6		0.02		ns
BW	-3dB Bandwidth (See Figure 6)	R_L = R_S = 50Ω, C_L = 0pF	3.0		720		MHz
		R_L = R_S = 50Ω, C_L = 5pF			550		
Isolation & Crosstalk							
O_{IRR}	Off Isolation (See Figure 8)	f = 240MHz, R_L = R_S = 50Ω	3.0		-30		dB
X_{TALK}	Channel Crosstalk (See Figure 9)	f = 240MHz, R_L = R_S = 50Ω	3.0		-45		dB
Capacitance							
C_{IN}	Control Pin Input Capacitance	f = 240MHz	0		1.5		pF
C_{ON}	ON Capacitance (See Figure 9)	f = 240MHz	3.6		7		pF
C_{OFF}	OFF Capacitance (See Figure 10)	f = 240MHz	3.6		3.5		pF

Note 1: These parameters are not production tested: Guaranteed by design correlation.

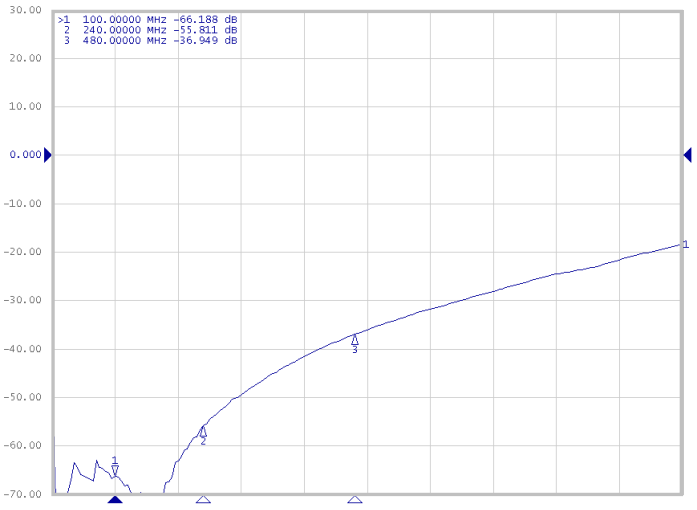
Typical Operating Characteristics



Eye diagram of MSI2001



Off Isolation



Crosstalk

Test Diagrams

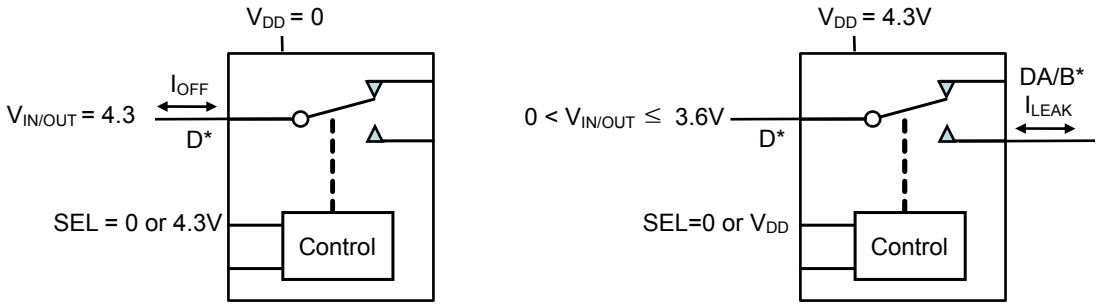


Figure 1. I_{OFF} & I_{LEAK} test circuit

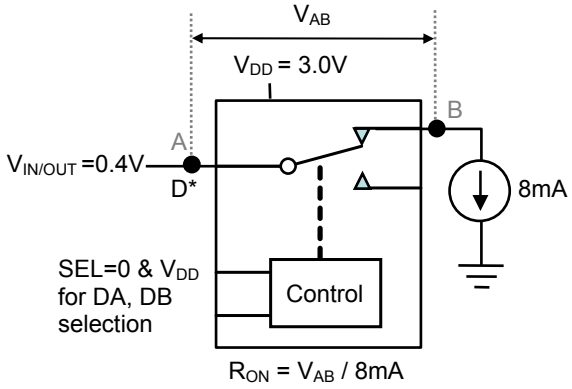


Figure 2. R_{ON} test circuit

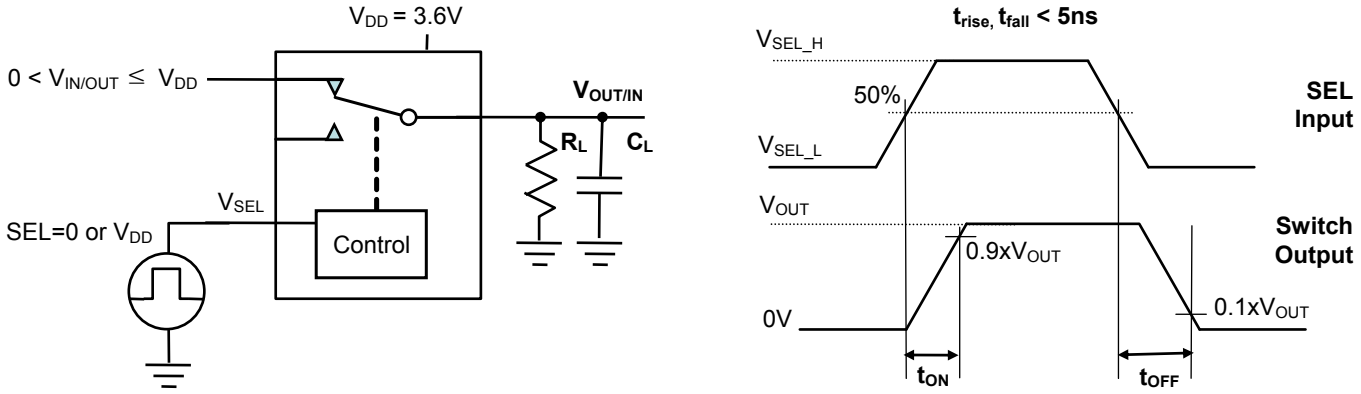
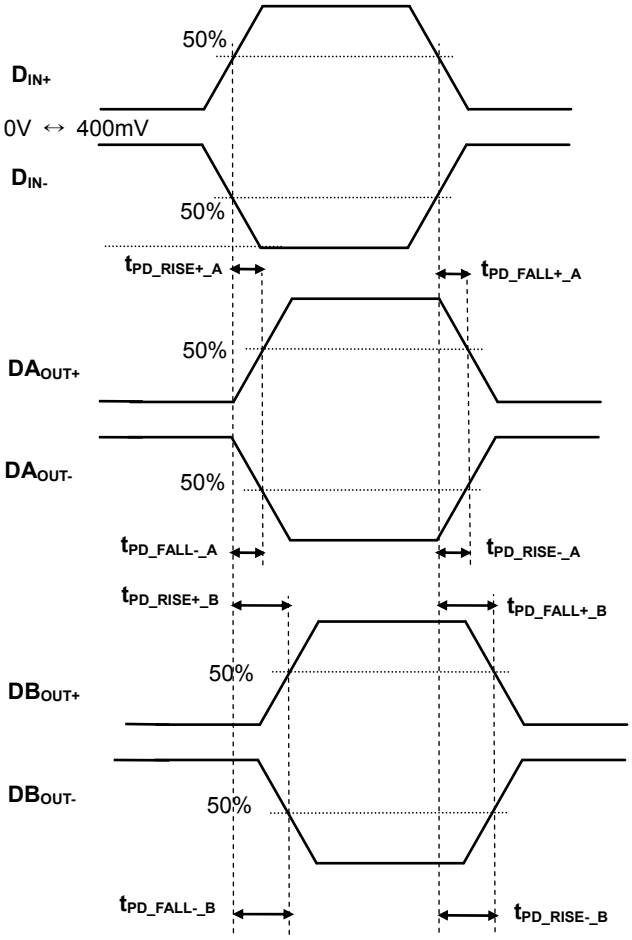


Figure 3. t_{ON}, t_{OFF} test circuit



RISE-TIME PROPAGATION DELAY

t_{PD_RISE+}, t_{PD_RISE-}

FALL-TIME PROPAGATION DELAY

t_{PD_FALL+}, t_{PD_FALL-}

OUTPUT SKEW BETWEEN SWITCHES

$t_{SK(O)} = | t_{PD\_RISE+/-\_A} - t_{PD\_RISE+/-\_B} |$ **or** $| t_{PD\_FALL+/-\_A} - t_{PD\_FALL+/-\_B} |$

OUTPUT SKEW SAME SWITCH

$t_{SK(P)} = | t_{PD\_RISE+\_A/B} - t_{PD\_FALL+\_A/B} |$ **or** $| t_{PD\_RISE-\_A/B} - t_{PD\_FALL-\_A/B} |$

Figure 4. Rise/ Fall propagation delay & Skew

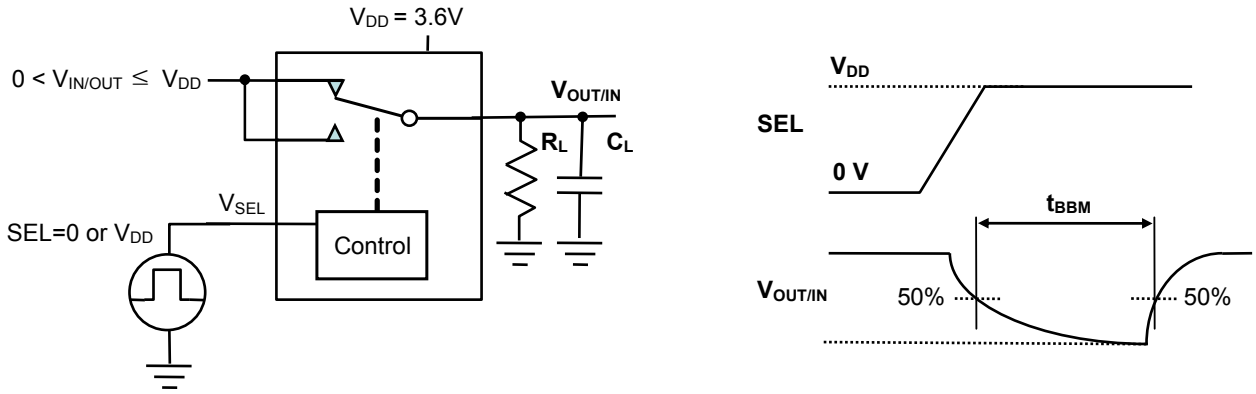


Figure 5. Break-Before-Make time

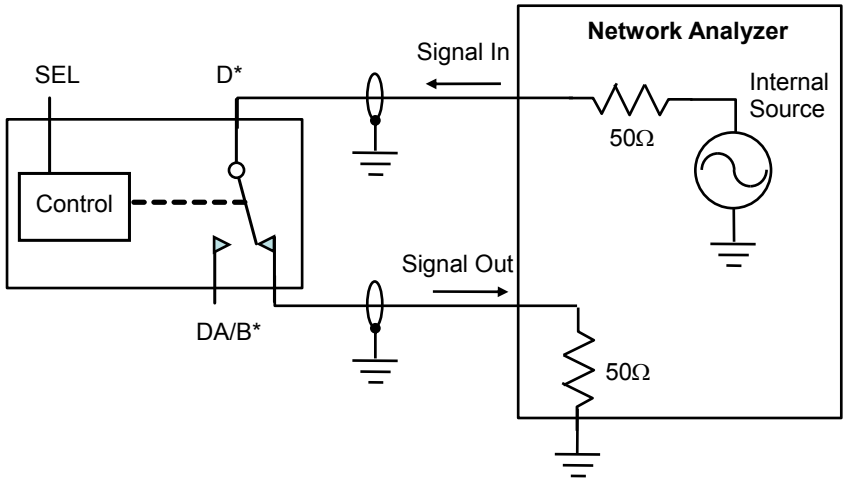


Figure 6. -3dB Bandwidth

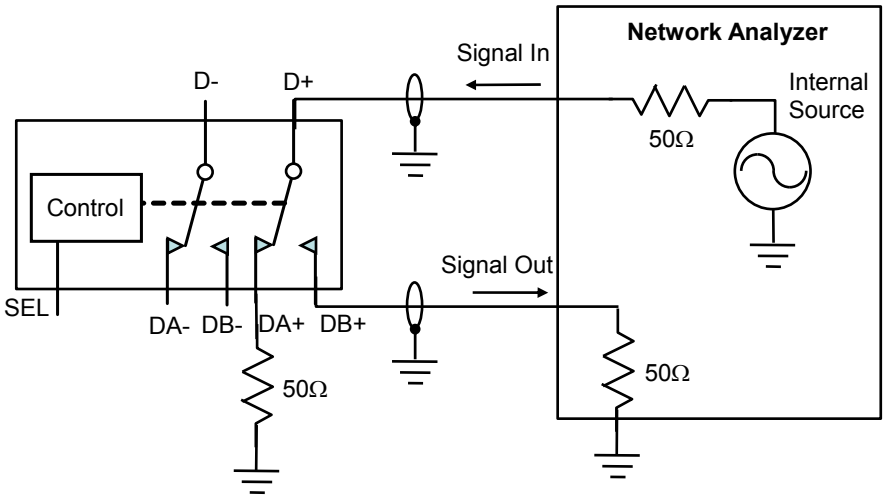


Figure 7. Off Isolation

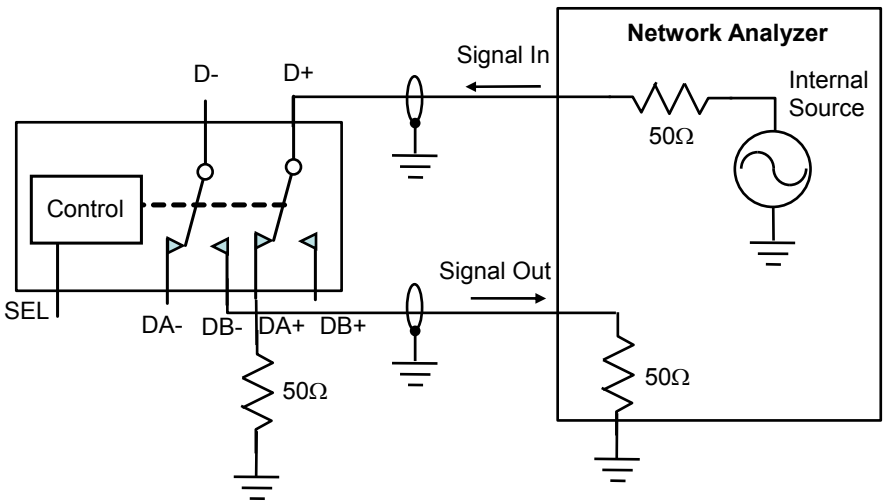


Figure 8. Channel Crosstalk

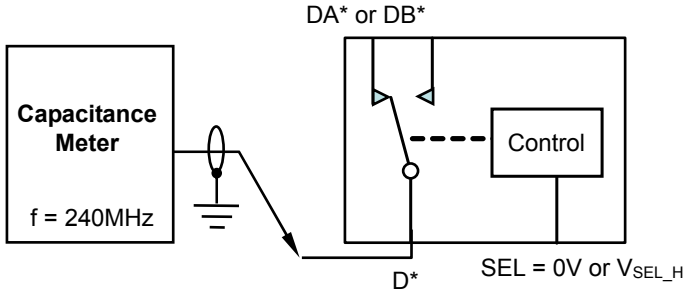


Figure 9. ON Capacitance

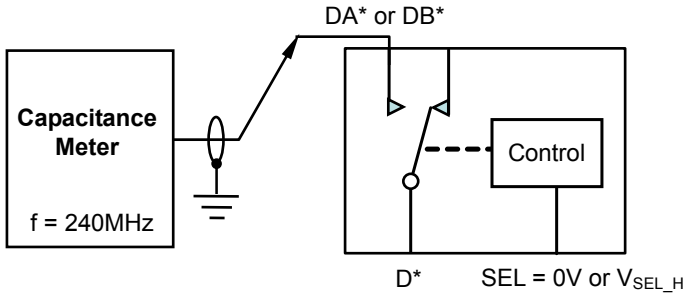
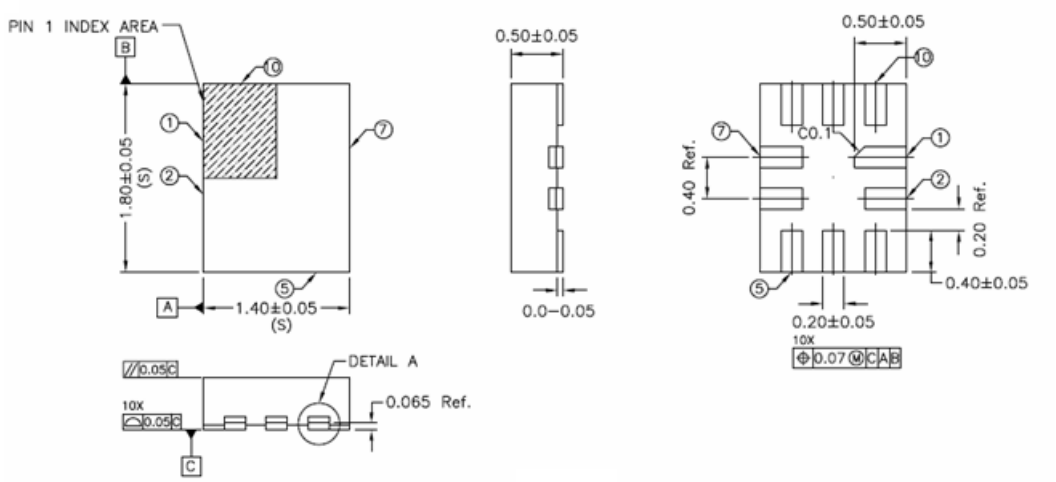


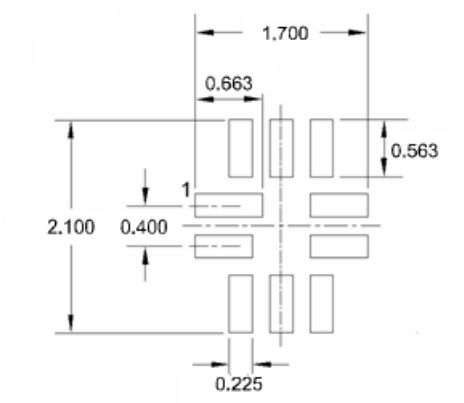
Figure 10. OFF Capacitance

Physical Dimensions

10-Lead, 1.4mmX1.8mm Thin QFN

Dimensions are in millimeters, unless otherwise noted.





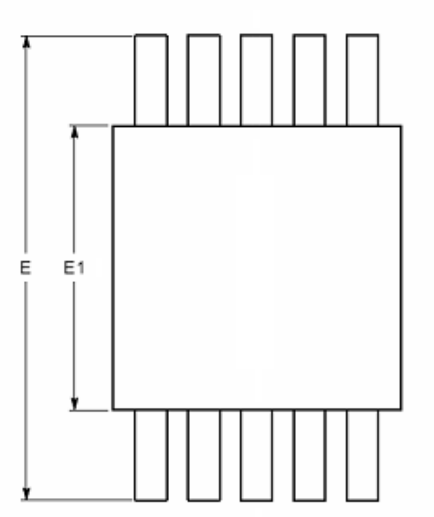
NOTE :

1. ALL DIMENSION ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS. COPLANARITY SHALL NOT EXCEED 0.05 mm.
3. WARPAGE SHALL NOT EXCEED 0.05 mm.
4. PACKAGE LENGTH / PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC.(S)
5. REFER JEDEC MO-236/MO-248

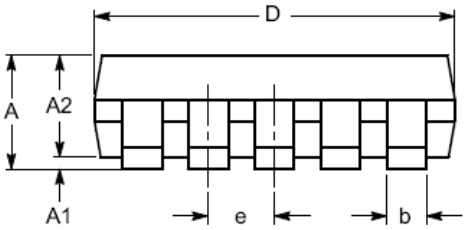
Physical Dimensions

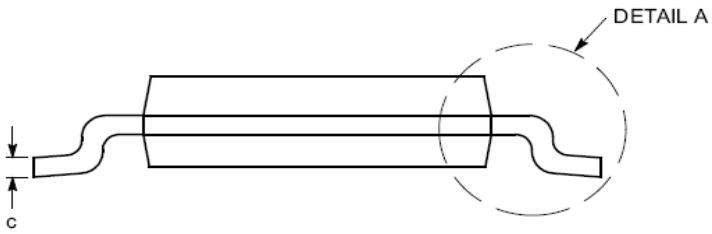
10-Lead, 3.0mmX4.9mm MSOP (Molded Small Outline Package)

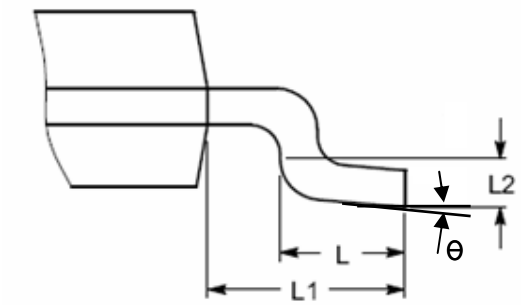
Dimensions are in millimeters, unless otherwise noted.



Symbol	Dimension (mm)		
	Min	Nom	Max
A	-	-	1.10
A1	0.00	-	0.15
A2	0.75	0.85	0.95
b	0.17	-	0.33
c	0.08	-	0.23
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.50 BSC		
L	0.40	0.60	0.80
L1	0.95 Ref		
L2	0.25 BSC		
θ	0°		8°







DETAIL A

DIV'D	NAME	DATE		TITLE	MSOP10 PACKAGE DRAWING		
DES.BY	Lewis. Park	2011.11.17		DWG.NO	N/A		
APR.BY	SD. Lee	2011.11.17		REV.NO	0	SHEET	1/1
SCALE	NA	UNIT	mm	MagnaChip			

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