High-Speed USB 2.0 (480-Mbps)
1:2 Multiplexer / Demultiplexer Switch

Features

- 1.8V to 5.5V Single Supply Operation
- Low Power Consumption (1µA Max.)
- Low ON-State Resistance: 10Ω Max.
- -3dB Bandwidth: 900 MHz Typical
- Fast Switching Speed
- Break-Before-Make Operation
- Rail-to-Rail Operation
- TTL/CMOS Logic Compatible
- Supports Analog and Digital Signals
- Small Packaging: MSOP10, UQFN10
- Extended Industrial Temperature Range: -40°C to +125°C

Applications

- Multiple-Purpose Signal Switching
- Routes Signals for USB1.0/1.1/2.0
- Portable Devices
- Set-Top Box
- Signal Gating, Multiplexer/Demultiplexer
- Signal Modulation or Demodulation
- Sample and Hold Systems
- Telecom Signal Switching
- Battery Power Systems

General Description

The COSUSB42 is a low voltage, high bandwidth double-pole / double-throw (DPDT) CMOS analog switch with single output enable control pin. The device can pass signals with rail-to-rail swing from a single supply 1.8V to 5.5V. The switches conduct equally well in both directions when it is on. The output enable pin place the signal paths in high impedance which isolates the bus when it is not in use and thus consume less current.

The COSUSB42 offers low ON-state resistance and excellent ON-state resistance matching with the break-before-make feature which prevents signal distortion during the transferring of a signal from one channel to another. The device is well suitable for the switching of high-speed USB 2.0 signals in handset and consumer applications with limited USB I/Os.
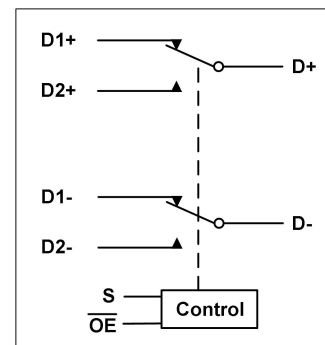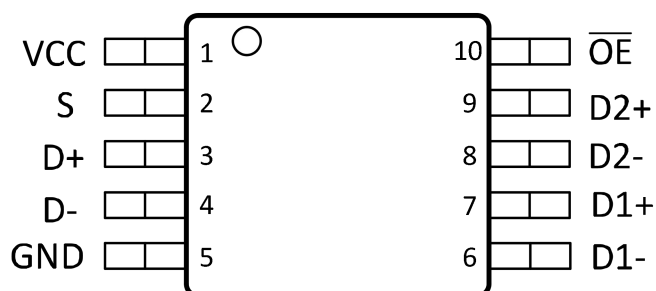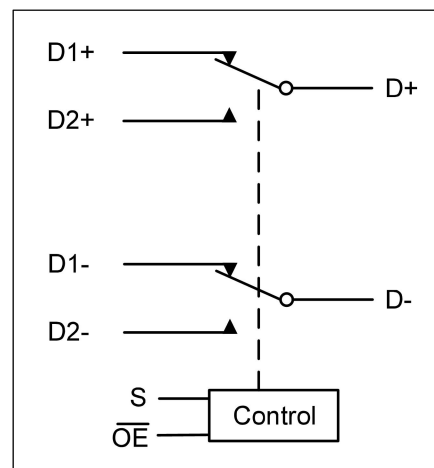

Simplified Schematic

1. Pin Configuration and Functions

(a) Pin Diagram

(b) Simplified Schematic

Truth Table

$\overline{OE}$	S	D1+, D1-	D2+, D2-
0	0	ON	OFF
0	1	OFF	ON
1	X	OFF	OFF

X=don't care

Pin Description

PIN			FUNCTION
NO.	NAME	I/O	
1	VCC	-	Power supply
2	S	I	Select input
3	D+	I/O	Common USB signal path
4	D-	I/O	Common USB signal path
5	GND	-	Ground
6	D1-	I/O	USB signal path port 1
7	D1+	I/O	USB signal path port 1
8	D2-	I/O	USB signal path port 2
9	D2+	I/O	USB signal path port 2
10	$\overline{OE}$	I	Output enable

2. Package and Ordering Information

Order Number	Package	Package Option	Marking Information
COSUSB42MUX	MSOP10	Tape and Reel, 3000	COSUSB42MUX
COSUSB42MUXQN	UQFN10	Tape and Reel, 3000	COSUSB42MUX

3. Product Specification

3.1 Absolute Maximum Ratings [1]

Parameter	Min	Max	Unit
Supply voltage range (V_{CC})	-0.5	6.0	V
Analog voltage range (V_{IO})	-0.5	V_{CC} + 0.5	V
Digital input voltage range (V_{IN})	-0.5	6.0	V
Continuous current into any terminal	-50	50	mA
Peak current into any terminal	-100	100	mA
Operating junction temperature	-40	+125	°C
Storage temperature	-55	+150	°C

(1) 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.

3.2 Thermal Data

Parameter	Rating	Unit
Package Thermal Resistance, $R_{\theta JA}$ (Juntion-to-ambient)	160 (MSOP10)	°C/W

3.3 Recommended Operating Conditions

Parameter	Min	Max	Unit
V_{CC}	1.8	5.5	V
V_{IO}	0	V_{CC}	
V_{IN}	0	V_{CC}	
T_A, Operating free-air temperature	-40	+85	°C

3.4 Electrical Characteristics

(V_{CC}=1.8V to 5.5V, T_A=-40°C to 85°C, Typical value are at V_{CC}=3.3V, T_A=25°C, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Analog Switch						
Analog signal range	V_{IS}		0		V_{CC}	V
On-state resistance	R_{on}	V_{CC}=3V, V_{IS} =0.4V, I_D = -8mA, Switch On, See Figure 1		6	10	Ω
On-state resistance match between channels	ΔR_{on}			0.35		Ω
On-state resistance flatness	$R_{on(flat)}$	V_{CC}=3V, V_{IS} =0V to 1V, I_D = -8mA, Switch On, See Figure 1		2		Ω
Power OFF leakage current	I_{OFF}	V_{CC}=0V, V_{IS} = 0V to 3.6V, V_S or V_{OE} = 0V or 3.6V, See Figure 2			±1	µA
OFF-state leakage current (D+, D-)	I_{OZ}	V_{CC}=3.6V, V_D = 0V to 3.6V, V_{IS}= 0V to 3.6V, Switch OFF, See Figure 2			±1	µA
Channel ON leakage current	$I_{D(OFF)}$	V_{CC}=3.6V, V_D = 0V to 3.6V, V_{IS}= 0V to 3.6V or floating, Switch ON, See Figure 3			±1	µA
Increase in I_{CC} per Control Voltage	ΔI_{CC}	V_{CC}=4.3V, V_{IN} =2.6V			10	µA
Digital Control Input (S, $\overline{OE}$)						
Input logic high	V_{IH}		2.4		5.5	V
Input logic low	V_{IL}		0		0.8	V
Input leakage current	I_{IH}, I_{IL}	V_{IN} = 0 or 5.5			±1	µA
Switch Dynamic Characteristics						
Turn-on time	t_{ON}	V_{IS} = 0.8V, R_L=50Ω, C_L = 5pF, See Figure 5		15		ns
Turn-off time	t_{OFF}			6		ns
Propagation delay	t_D	R_L=50Ω, C_L = 5pF		0.3		ns
Break-before-make delay	t_{BBM}	V_{IS} = 0.8V, R_L=50Ω, C_L = 5pF, See Figure 6		4		ns
Charge injection	Q	V_{GEN} =0V, R_{GEN}=0, C_L = 1 nF, See Figure 10		10		pC
OFF-state capacitance	$C_{I/O(OFF)}$	V_{CC} = 3.3V, $V_{I/O}$ = V_{CC} or 0, Switch OFF, See Figure 4		5		pF
ON-state capacitance	$C_{I/O(ON)}$	V_{CC} = 3.3V, $V_{I/O}$ = V_{CC} or 0, Switch ON, See Figure 4		10		pF
Digital input capacitance	C_I	V_{CC} = 0V, V_{IN} = V_{CC} or 0, See Figure 4		1		pF

OFF-isolation	V_{ISO}	R_L = 50Ω, C_L = 5pF, $V_{I/O}$ = 1V_{RMS}, f = 1MHz Switch OFF, See Figure 8		-40		dB
Crosstalk	X_{TALK}	R_L = 50Ω, C_L = 5pF, $V_{I/O}$ = 1V_{RMS}, f = 1MHz Switch ON, See Figure 9		-60		dB
Bandwidth	BW	R_L = 50Ω, C_L = 5pF, $V_{I/O}$ = 1V_{RMS}, f = 1MHz Switch ON, See Figure 7		900		MHz
Power Supply						
V_{CC} supply range	V_{CC}		1.8		5.5	V
V_{CC} supply current	I_{CC}	V_{CC}=4.3V, $I_{I/O}$ = 0, Switch ON or OFF			1	μA

4. Test Circuits and Timing Diagrams
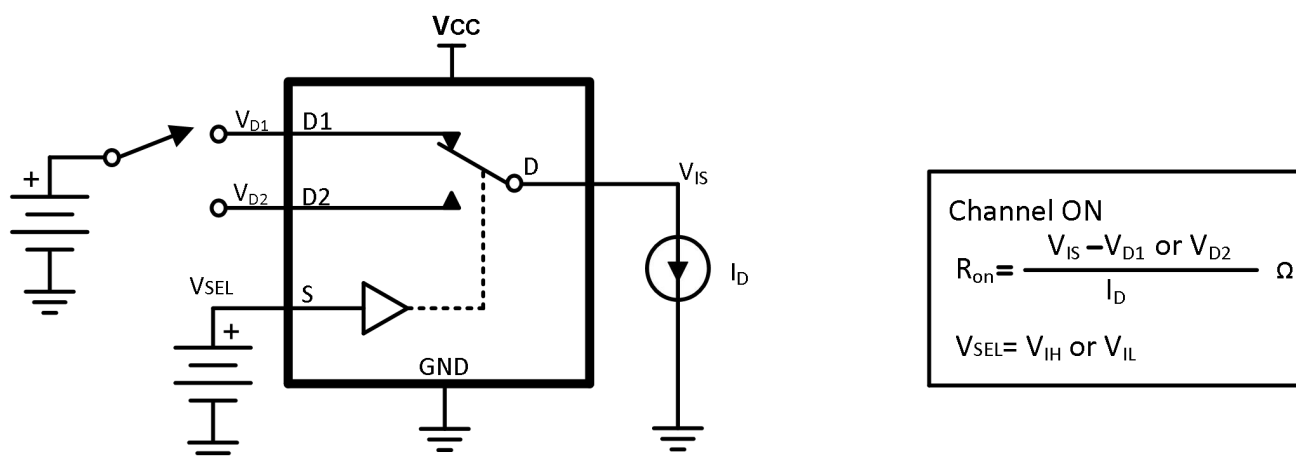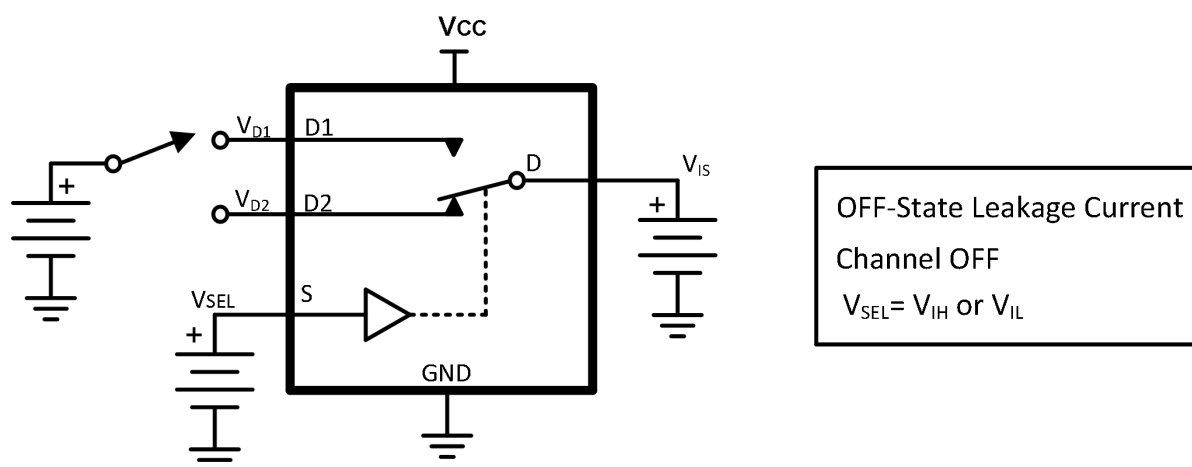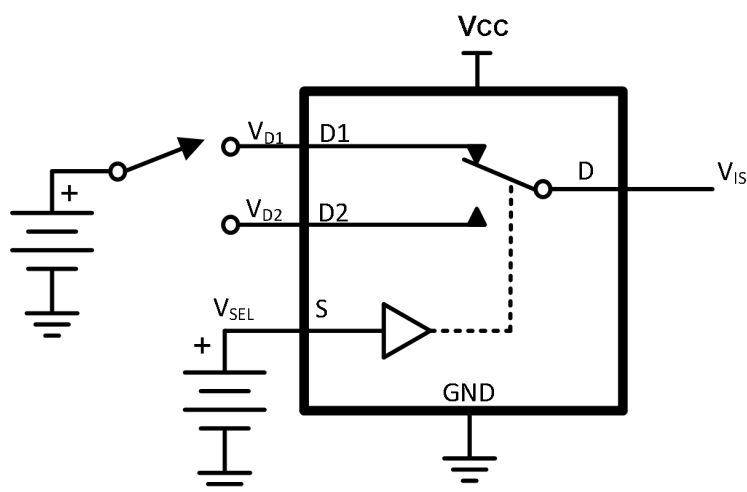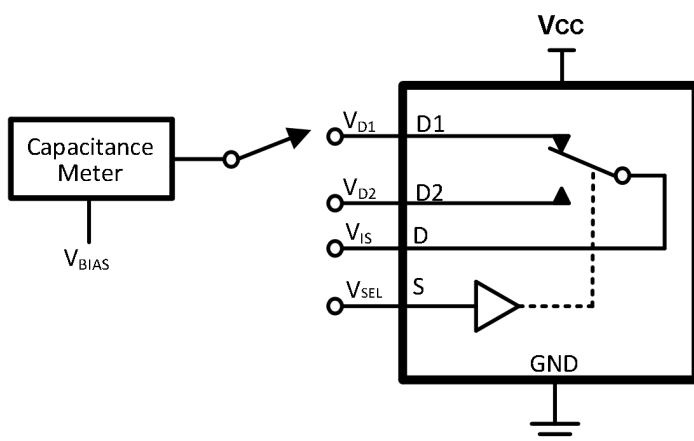

Figure 1. ON-State Resistance (R_{ON})

Figure 2. OFF-State Leakage Current

Vcc

V_{D1} D1

V_{D2} D2

D V_{IS}

V_{SEL} S

GND

ON-State Leakage Current

Channel ON

$V_{SEL} = V_{IH}$ or V_{IL}

Figure 3. ON-State Leakage Current

Vcc

Capacitance Meter

V_{BIAS}

V_{D1} D1

V_{D2} D2

V_{IS} D

V_{SEL} S

GND

$V_{BIAS} = V_{CC}$ or GND

$V_{SEL} = V_{CC}$ or GND

Capacitance is measured at D1, D2, D, and S inputs during ON and OFF conditions.
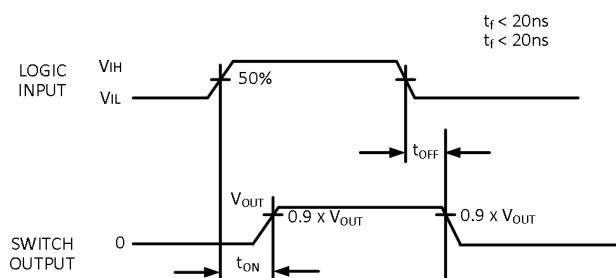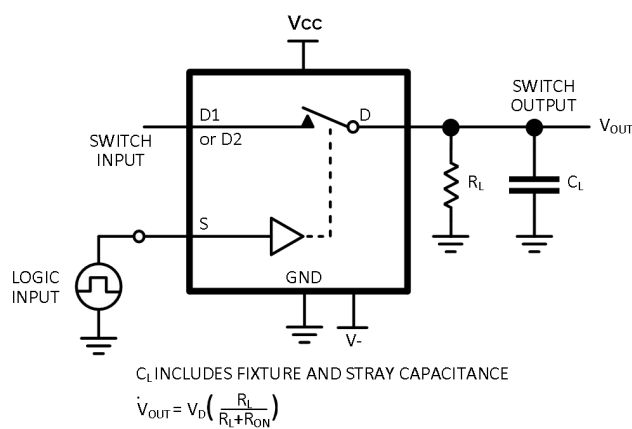
Figure 4. Capacitance

Vcc

D1 or D2

SWITCH INPUT

D

SWITCH OUTPUT

V_{OUT}

R_L

C_L

S

LOGIC INPUT

GND

V-

C_L INCLUDES FIXTURE AND STRAY CAPACITANCE

$V_{OUT} = V_D \left(\dfrac{R_L}{R_L + R_{ON}} \right)$

$t_f < 20ns$
$t_f < 20ns$

LOGIC INPUT

V_{IH}
V_{IL}

50%

t_{OFF}

V_{OUT}

SWITCH OUTPUT

0

$0.9 \times V_{OUT}$

$0.9 \times V_{OUT}$

t_{ON}

LOGIC INPUT WAVEFORMS INVERTED FOR SWITCHES THAT HAVE THE OPPOSITE LOGIC SENSE.

Figure 5. Turn-On (T_{ON}) and Turn-Off Time (T_{OFF})
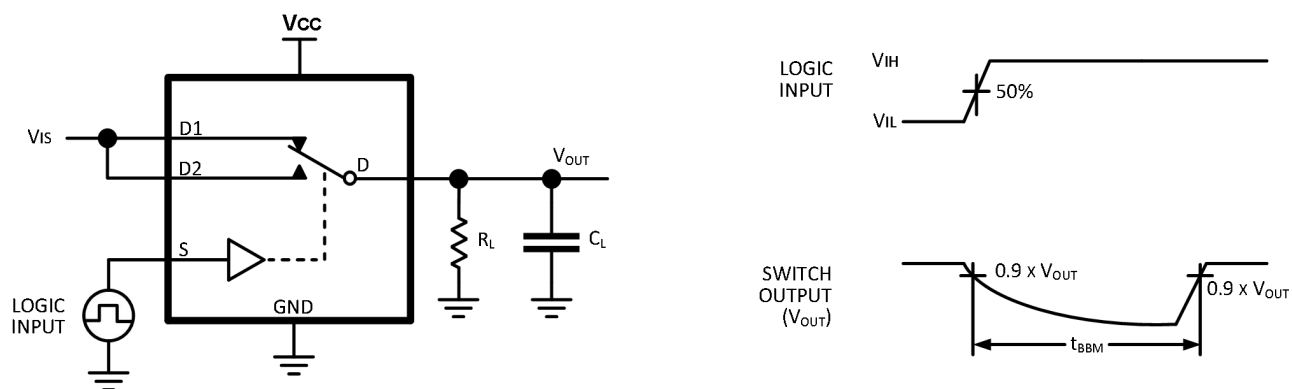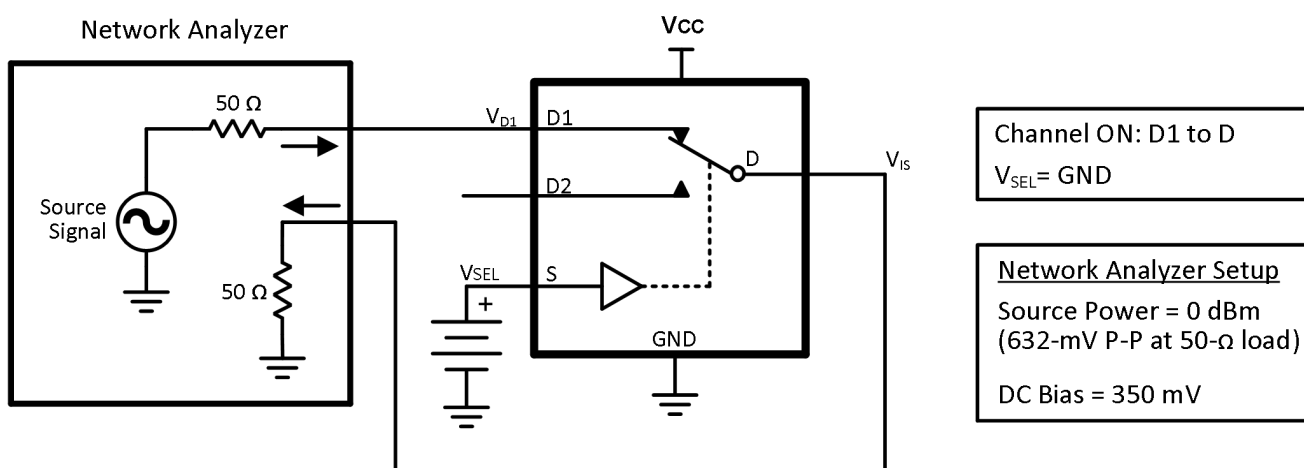
Figure 6. Break-Before-Make Time (T_{BBM})

Channel ON: D1 to D
V_{SEL}= GND

Network Analyzer Setup
Source Power = 0 dBm
(632-mV P-P at 50-Ω load)

DC Bias = 350 mV

Figure 7. Bandwidth (BW)

Channel OFF: D1 to D
V_{SEL}= V_{CC}

Network Analyzer Setup
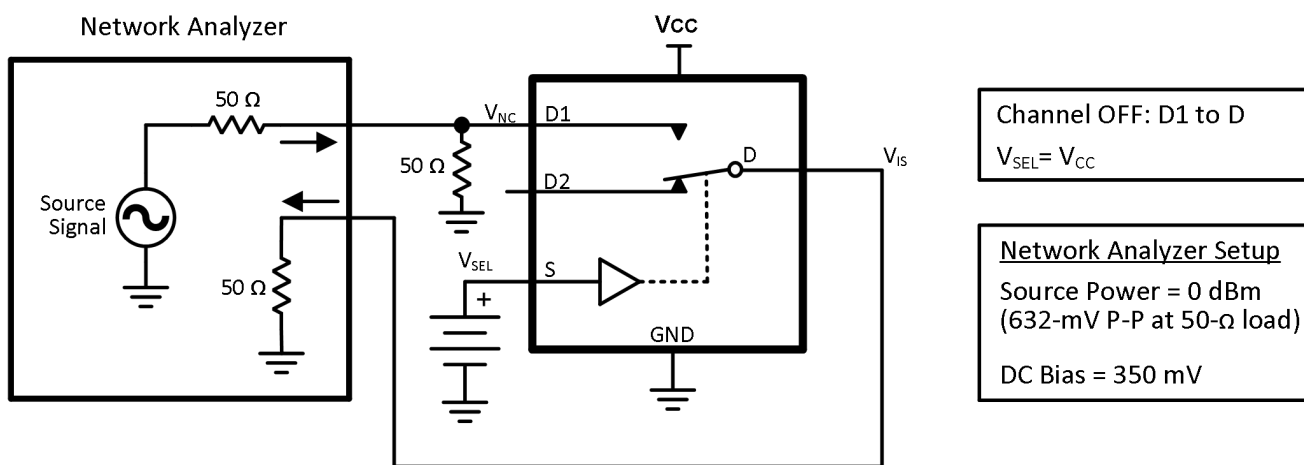Source Power = 0 dBm
(632-mV P-P at 50-Ω load)

DC Bias = 350 mV

Figure 8. OFF Isolation (O_{ISO})
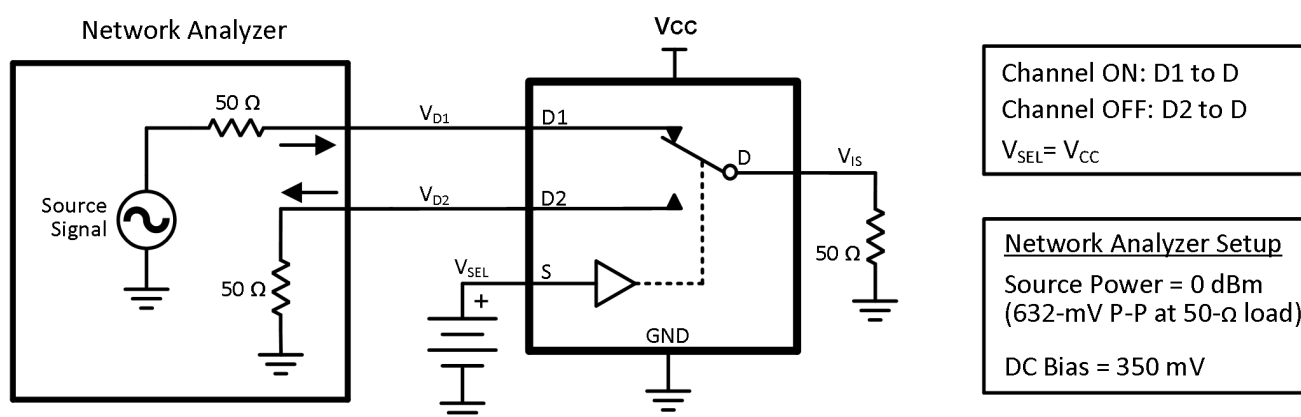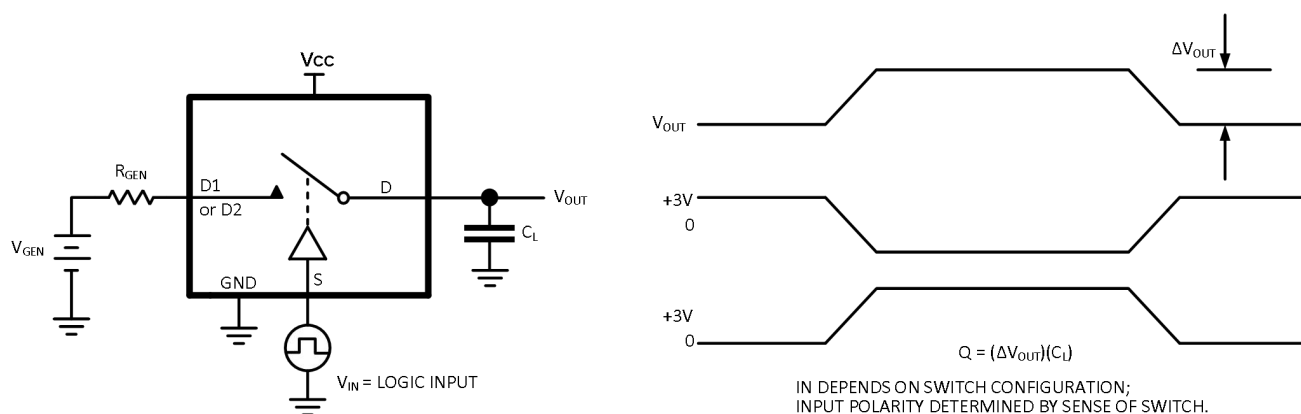
Figure 9. Crosstalk (X_{TALK})

Figure 10. Charge Injection (Qc)

5. Typical Application

COSUSB42 can be used to connect a single controller to two USB connectors or controllers as shown in Figure 11. There are many USB applications in which the USB hubs or controllers have a limited number of USB I/Os. The COSUSB42 can effectively expand the limited USB I/Os by switching between multiple USB buses in order to interface them to a single USB hub or controller.

The COSUSB42 can properly operate without any external components. However, it is recommended that unused pins be connected to ground through a 50-Ω resistor to prevent signal reflections back into the device. The digital control pins S and $\overline{OE}$ should be pulled up to Vcc or down to GND to avoid undesired switch positions that could result from the floating pin.
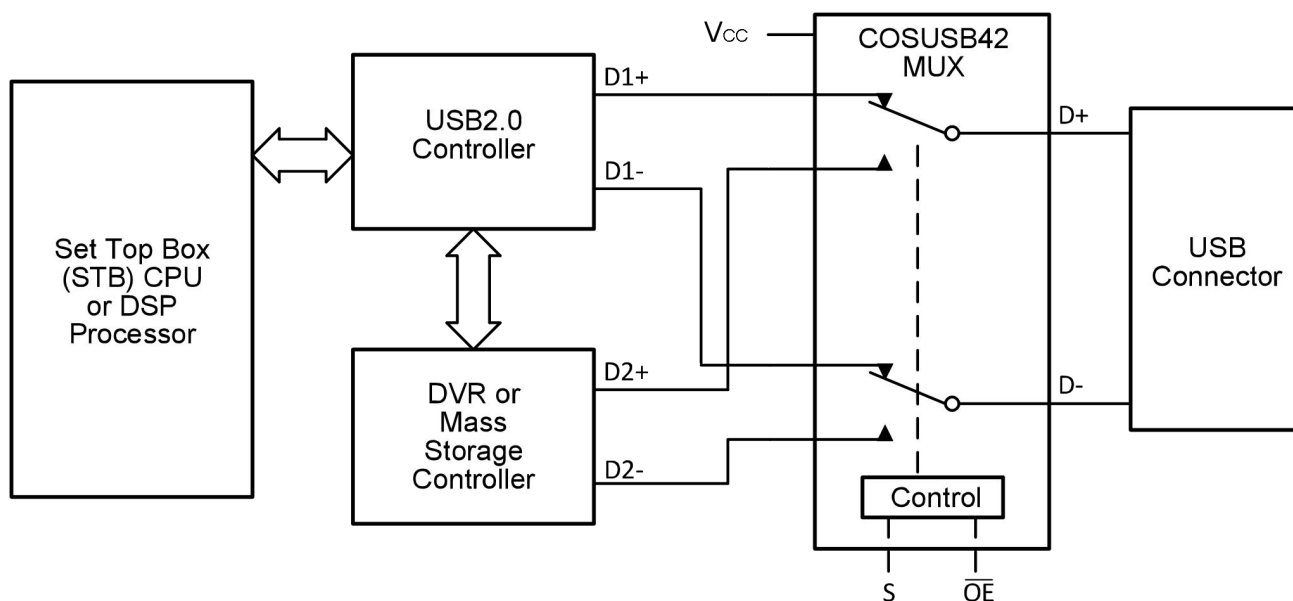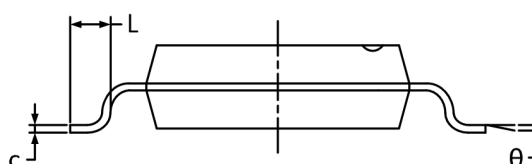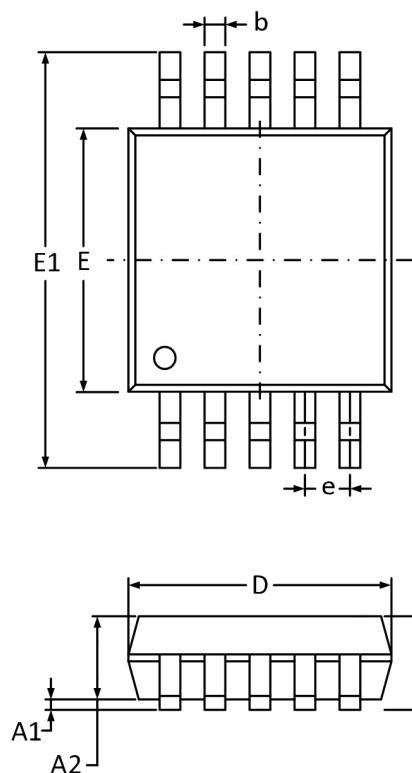
Figure 11. Typical Application Diagram

6. Package Information

6.1 MSOP10 (Package Outline Dimensions)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°