

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: 100 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**

Rev1.0

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General Description

The COSTS3USB30E 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 COSTS3USB30E 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.







1. Pin Configuration and Functions



(a) Pin Diagram



(b) Simplified Schematic

Truth	Table
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OE	S	D1+, D1-	D2+, D2-
0	0	ON	OFF
0	1	OFF	ON
1	Х	OFF	OFF

X=don't care

Pin Description

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



2. Package and Ordering Information

Order Number	Package	Package Option	Marking Information
COSTS3USB30E	MSOP10	Tape and Reel, 3000	COSTS3/USB30E
COSTS3USB30EQN	UQFN10	Tape and Reel, 3000	COSTS3/USB30E

3. Product Specification

3.1 Absolute Maximum Ratings⁽¹⁾

Parameter	Min	Мах	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 _{eJA} (Juntion-to-ambient)	160 (MSOP10)	°C/W

3.3 Recommended Operating Conditions

Parameter	Min	Мах	Unit
Vcc	1.8	5.5	
V _{IO}	0	Vcc	V
Vin	0	Vcc	
T _A , Operating free-air temperature	-40	+85	°C



3.4 Electrical Characteristics

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

Parameter	Symbol	Conditions	Min.	Тур.	Max.	Unit
Analog Switch						
Analog signal range	Vis		0		Vcc	V
On-state resistance	Ron	Vcc=3V, V _{IS} =0.4V,		6	10	Ω
On-state resistance match between channels	ΔR_{on}	I _D = -8mA, Switch On, See Figure 1		0.35		Ω
On-state resistance flatness	R _{on(flat)}	Vcc=3V, V _{IS} =0V to 1V, I _D = -8mA, Switch On, See Figure 1		2		Ω
Power OFF leakage current	IOFF	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-)	loz	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	ID(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	ΔIcc	Vcc=4.3V, V _{IN} =2.6V			10	μA
Digital Control Input (S, OE)					
Input logic high	VIH		2.4		5.5	V
Input logic low	VIL		0		0.8	V
Input leakage current	I _{IH,} I _{IL}	V _{IN} = 0 or 5.5			±1	μA
Switch Dynamic Character	istics					
Turn-on time	t _{ON}	V _{IS} = 0.8V, R∟=50Ω,		15		ns
Turn-off time	t _{OFF}	C_{L} = 5pF, See Figure 5		6		ns
Propagation delay	t _D	R _L =50Ω, C _L = 5pF		0.3		ns
Break-before-make delay	t _{BBM}	$V_{IS} = 0.8V$, $R_L=50\Omega$, $C_L = 5pF$, See Figure 6		4		ns
Charge injection	Q	$V_{GEN} = 0V, R_{GEN} = 0,$ $C_L = 1 nF, See Figure 10$		10		рС
OFF-state capacitance	CI/O(OFF)	$V_{CC} = 3.3V$, $V_{I/O} = V_{CC}$ or 0, Switch OFF, See Figure 4		5		pF
ON-state capacitance	CI/O(ON)	$V_{CC} = 3.3V$, $V_{I/O} = V_{CC}$ or 0, Switch ON, See Figure 4		10		pF
Digital input capacitance	Cı	$V_{CC} = 0V$, $V_{IN} = V_{CC}$ or 0, See Figure 4		1		pF



OFF-isolation	V _{ISO}	$R_L = 50\Omega$, $C_L = 5pF$, $V_{I/O} = 1V_{RMS}$, f = 1MHz Switch OFF, See Figure 8		-40		dB
Crosstalk	X _{TALK}	$R_L = 50\Omega$, $C_L = 5pF$, $V_{I/O} = 1V_{RMS}$, 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	Vcc		1.8		5.5	V
V _{cc} supply current	Icc	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 (RoN)









ON-State Leakage Current Channel ON V_{SEL}= V_{IH} or V_{IL}







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





Figure 5. Turn-On (T_{ON}) and Turn-Off Time (T_{OFF})





Figure 6. Break-Before-Make Time (T_{BBM})













Figure 9. Crosstalk (X_{TALK})



Figure 10. Charge Injection (Qc)

5. Typical Application

COSTS3USB30E 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 COSTS3USB30E 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 COSTS3USB30E 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
А	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
с	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	DBSC
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

A1