High-Speed USB 2.0(480 Mbps) DPDT Switches

DESCRIPTION

The SUM7222 is 2- to 1-port analog switches. Their wide bandwidth and low bit-to-bit skew allow them to pass high-speed differential signals with good signal integrity. Each switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. Industry-leading advantages include a propagation delay of less than 250 ps, resulting from its low channel resistance and low I/O capacitance. Their high channel-to-channel crosstalk rejection results in minimal noise interference. Their bandwidth is wide enough to pass High-Speed USB 2.0 differential signals (480 Mb/s).

FEATURES

- R_{ON} is Typically 6.0 Ω at V_{CC} = 3.3 V
- Low Bit-to-Bit Skew: Typically 50 ps
- Low Crosstalk: -45 dB @ 250 MHz
- Low Current Consumption: 1.0 μA
- Near-Zero Propagation Delay: 250 ps
- Channel On-Capacitance: 4.0 pF (Typical)
- V_{CC} Operating Range: 1.65 V to 5.25 V
- >750 MHz Bandwidth (or Data Frequency)
- Package: QFN1.8 × 1.4-10

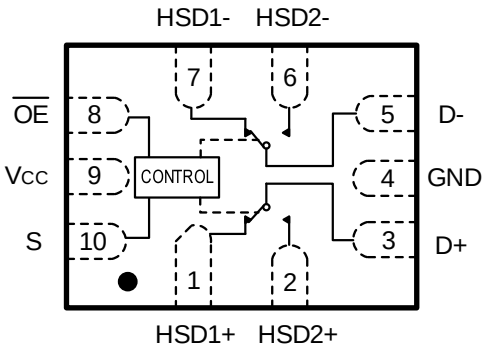
APPLICATIONS

- Differential Signal Data Routing
- USB 2.0 Signal Routing

ORDER INFORMATION

Model	Package	Ordering number	Packing Option
SUM7222	QFN1.8 × 1.4-10	SUM7222QN	Tape and Reel, 3000

PIN CONFIGURATION (Top View)



QFN1.8×1.4-10

PIN FUNCTION

Pin Name	Function
S	Select Input
$\overline{OE}$	Output Enable
HSD1+, HSD1-, HSD2+, HSD2-, D+, D-	Data Ports

TRUTH TABLE

$\overline{OE}$	S	HSD1+, HSD1-	HSD2+, HSD2-
1	X	OFF	OFF
0	0	ON	OFF
0	1	OFF	ON

ABSOLUTE MAXIMUM RATINGS

Symbol	Pins	Parameter	Value	Unit
V_{CC}	V_{CC}	Positive DC Supply Voltage	-0.5 to +5.5	V
V_{IS}	HSD1+, HSD1-, HSD2+, HSD2-	Analog Signal Voltage	-0.5 to V_{CC} + 0.3	V
	D+, D-		-0.5 to +5.5	
V_{IN}	$\overline{OE}$	Control Input Voltage	-0.5 to +5.5	V
I_{CC}	V_{CC}	Positive DC Supply Current	50	mA
T_S		Storage Temperature	-65 to +150	℃
I_{IS_CON}	HSD1+, HSD1-, HSD2+, HSD2- D+, D-	Analog Signal Continuous Current-Closed Switch	±100	mA
I_{IS_PK}	HSD1+, HSD1-, HSD2+, HSD2- D+, D-	Analog Signal Continuous Current 10% Duty Cycle	±150	mA
I_{IN}	$\overline{OE}$	Control Input Current	±20	mA
ESD	Contact	IEC 61000-4-2 System on USB Connector Pins D+, D-	8	kV
	Charged Device Model, JEDEC: JESD22-C101		2	

Stresses beyond those listed under “ABSOLUTE MAXIMUM RATINGS” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
Note 1. Defined as 10% ON, 90% off duty cycle.

CAUTION

This integrated circuit can be damaged by ESD if you don’t pay attention to ESD protection. SUMSEMI recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

SUMSEMI reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SUMSEMI sales office to get the latest datasheet.

RECOMMENDED OPERATING CONDITIONS

Symbol	Pins	Parameter	Min	Max	Unit
V_{CC}		Positive DC Supply Voltage	1.65	5.25	V
V_{IS}	HSD1+, HSD1-, HSD2+, HSD2-	Analog Signal Voltage	GND	V_{CC}	V
	D+, D-		GND	5.25	
V_{IN}	$\overline{OE}$	Digital Select Input Voltage	GND	V_{CC}	V
T_A		Operating Temperature	-40	+85	℃

Minimum and maximum values are guaranteed through test or design across the Recommended Operating Conditions, where applicable. Typical values are listed for guidance only and are based on the particular conditions listed for section, where applicable. These conditions are valid for all values found in the characteristics tables unless otherwise specified in the test conditions.

DC ELECTRICAL CHARACTERISTICS

Control Input (Typical: T = 25°C, V_{CC} = 3.3 V)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40℃ to +85℃			unit
					Min	Typ	Max	
V_{IH}	$\overline{OE}$	Control Input High Voltage		2.7 3.3 4.2	1.3 1.4 1.6	-	-	V
V_{IL}	$\overline{OE}$	Control Input Low Voltage		2.7 3.3 4.2	-		0.4 0.4 0.5	V
I_{IN}	$\overline{OE}$	Control Input Leakage Current	$0 \le V_{IS} \le V_{CC}$	1.65 ~ 5.25	-	-	±1.0	μA

Supply and Leakage Current (Typical: T = 25°C, V_{CC} = 3.3 V)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40℃ to +85℃		unit
					Min	Max	
I_{CC}	V_{CC}	Quiescent Supply Current	V_{IS} = V_{CC} or GND; I_{OUT} = 0A	1.65 ~ 5.25	-	1.0	μA
I_{CCT}	V_{CC}	Increase in I_{CC} per Control Voltage	V_{IN} = 2.6V	3.6	-	10	μA
I_{OZ}	HSD1+, HSD1-, HSD2+, HSD2-	OFF Stage Leakage Current	$0 \le V_{IS} \le V_{CC}$	1.65 ~ 5.25	-	±1.0	μA
I_{OFF}	D+,D-	Power OFF Leakage Current	$0 \le V_{IS} \le 5.25V$	0	-	±1.0	μA

High Speed on Resistance (Typical: T = 25°C, V_{CC} = 3.3 V)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40℃ to +85℃			unit
					Min	Typ	Max	
R_{ON}		On-Resistance	V_{IS} = 0 V to 0.4 V, I_{ON} = 8 mA	2.7 3.3 4.2	-	6.5 6.0 5.5	12 10 8.0	Ω
R_{FLAT}		On-Resistance Flatness	V_{IS} = 0 V to 1.0 V, I_{ON} = 8 mA	2.7 3.3 4.2	-	0.6 0.5 0.4	-	Ω
$\triangle R_{ON}$		On-Resistance Matching	V_{IS} = 0 V to 0.4 V, I_{ON} = 8 mA	2.7 3.3 4.2	-	0.25 0.2 0.15	-	Ω

DC ELECTRICAL CHARACTERISTICS (Continued)

Full Speed on Resistance (Typical: T = 25°C, V_{CC} = 3.3 V)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40℃ to +85℃			unit
					Min	Typ	Max	
R_{ON}		On-Resistance	V_{IS} = 0 V to V_{CC}, I_{ON} = 8 mA	2.7 3.3 4.2	-	9.0 7.5 6.0	12 10.5 8.5	Ω
R_{FLAT}		On-Resistance Flatness	V_{IS} = 0 V to 1.0 V, I_{ON} = 8 mA	2.7 3.3 4.2	-	0.6 0.5 0.4	-	Ω
$\triangle R_{ON}$		On-Resistance Matching	V_{IS} = 0 V to V_{CC}, I_{ON} = 8 mA	2.7 3.3 4.2	-	1.20 1.45 1.65	-	Ω

AC ELECTRICAL CHARACTERISTICS

Timing/Frequency (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 5 pF, f = 1 MHz)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40℃ to +85℃			unit
					Min	Typ	Max	
t_{ON}	Closed to Open	Turn-ON Time		1.65 ~ 5.25	-	14	30	ns
t_{OFF}	Open to Closed	Turn-OFF Time		1.65 ~ 5.25	-	10	20	ns
t_{BBM}		Break-Before-Make Delay	V_{IS} = 0 V to V_{CC}, I_{ON} = 8 mA	1.65 ~ 5.25	-	2.20 2.45 2.65	-	ns
BW		-3dB Bandwidth	C_L = 5 pF	1.65 ~ 5.25	-	550	-	MHz
			CL = 0 pF		-	750	-	

Isolation (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 5 pF, f = 1 MHz)

Symbol	Pins	Parameter	Test Conditions	V_{CC}(V)	-40℃ to +85℃			unit
					Min	Typ	Max	
O_{IRR}	Open	OFF-Isolation	f = 250 MHz	1.65 ~ 5.25	-	-30	-	dB
X_{TALK}	HSD1+ to HSD1-	Non-Adjacent Channel Crosstalk	f = 250 MHz	1.65 ~ 5.25	-	-45	-	dB

Capacitance (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 5 pF, f = 1 MHz)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40℃ to +85℃			unit
					Min	Typ	Max	
C_{IN}	$\overline{OE}$	Control Pin Input Capacitance		0		1.8		pF
C_{ON}	D+ to HSD1 + or HSD2+	ON Capacitance	$\overline{OE}$ = 0 V	3.3		4.0		pF
C_{OFF}	HSD2+, HSD2-	OFF Capacitance	V_{IS} = 3.3 V; $\overline{OE}$ = 3.3 V	3.3		2.2		pF

TYPICAL PERFORMANCE CHARACTERISTICS

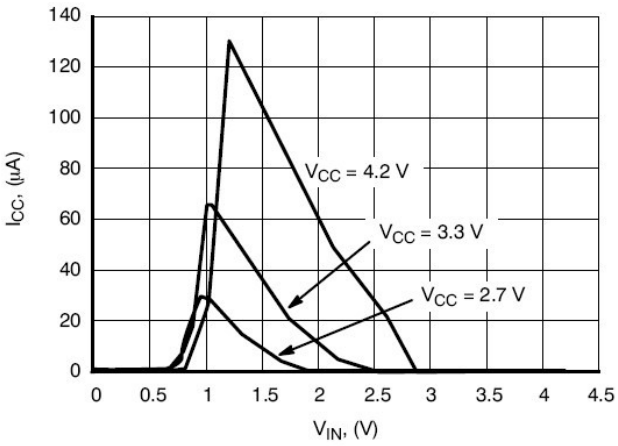


Figure1- a. I_{CC} vs. V_{IN}

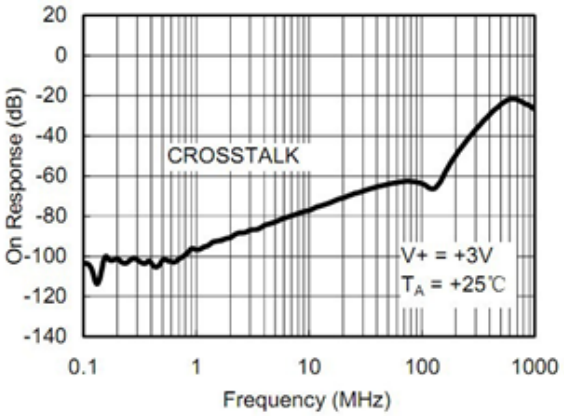


Figure1- b. Response vs. frequency

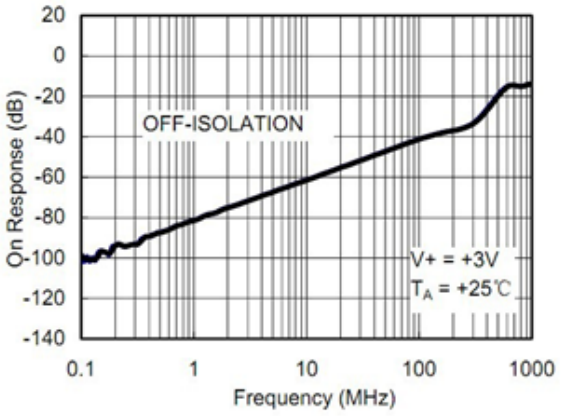
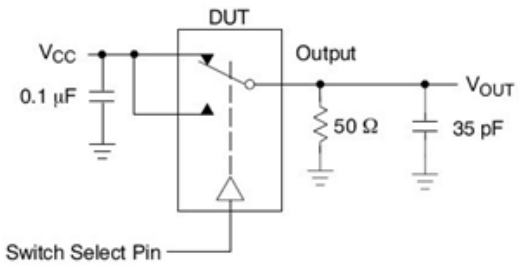


Figure1- c. Response vs. frequency

TEST CIRCUITS



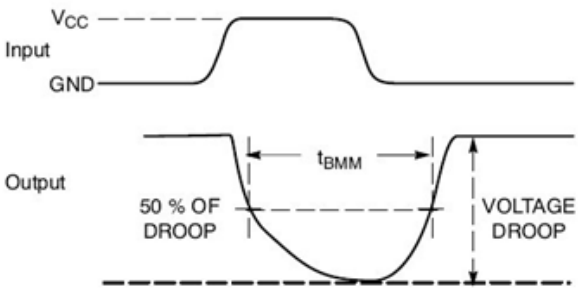


Figure2. t_{BBM} (Time Break-Before-Make)

TEST CIRCUITS (Continued)

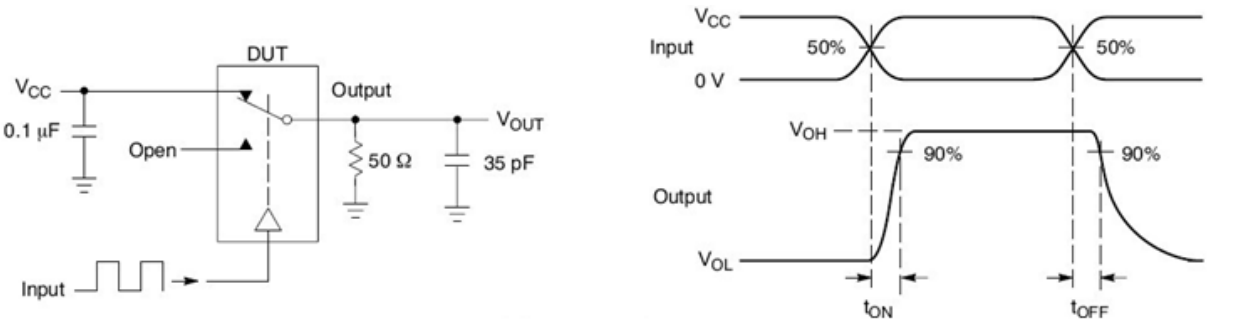


Figure3. t_{ON}/t_{OFF}

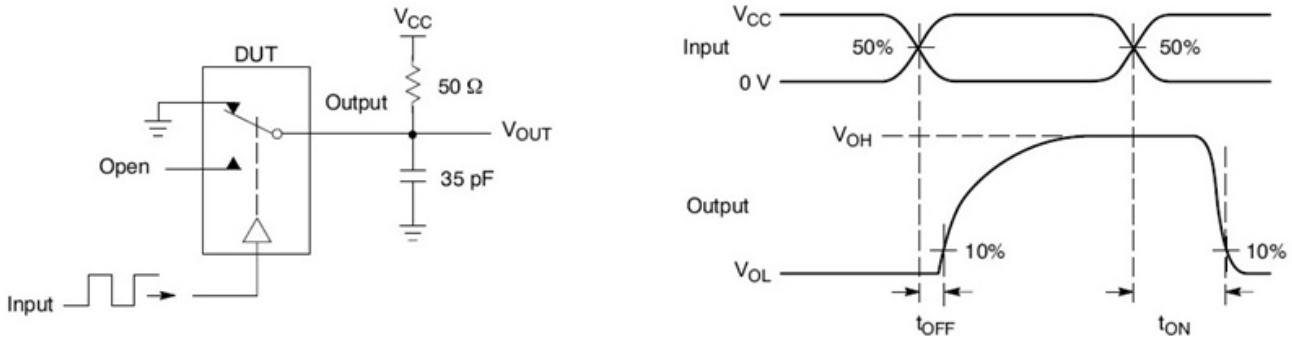


Figure4. t_{ON}/t_{OFF}

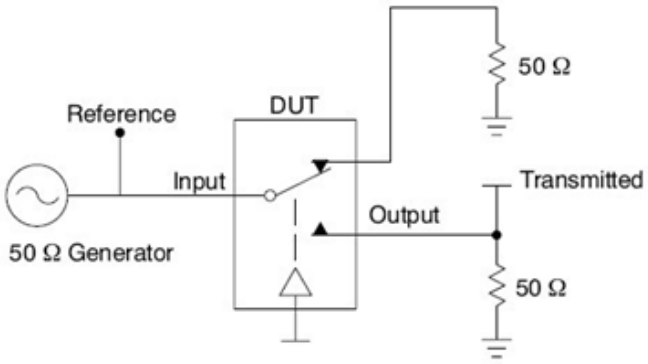


Figure5. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/V_{ONL}

Channel switch control test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch. V_{ISO}, Bandwidth and V_{ONL} are independent of the input signal direction.

V_{ISO} = Off Channel Isolation = 20Log($\frac{VOUT}{VIN}$) for V_{IN} at 100 kHZ

V_{ONL} = On Channel Loss = 20Log($\frac{VOUT}{VIN}$) for V_{IN} at 100 kHz to 50 MHz

Bandwidth (BW) = the frequency 3 dB below V_{ONL}

V_{CT} = Use V_{ISO} setup and test to all other switch analog input/outputs terminated with 50 Ω

TYPICAL PERFORMANCE CURVES

T_A = +25°C, Unless Otherwise Specified

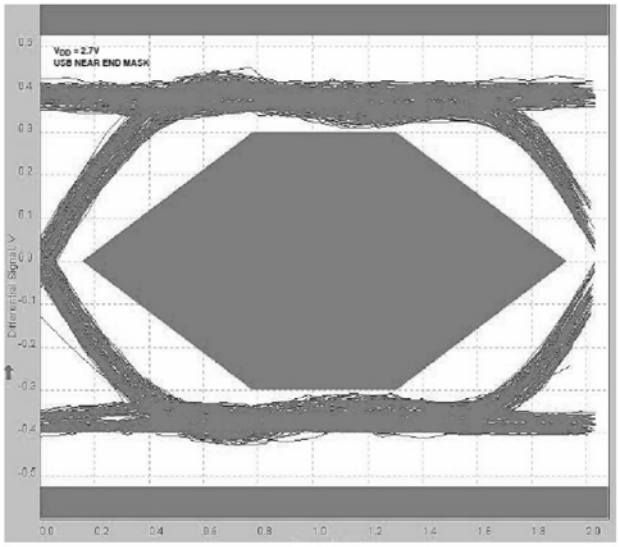


Figure6. Eye Pattern: 480Mbps with USB Switches in the Signal Path

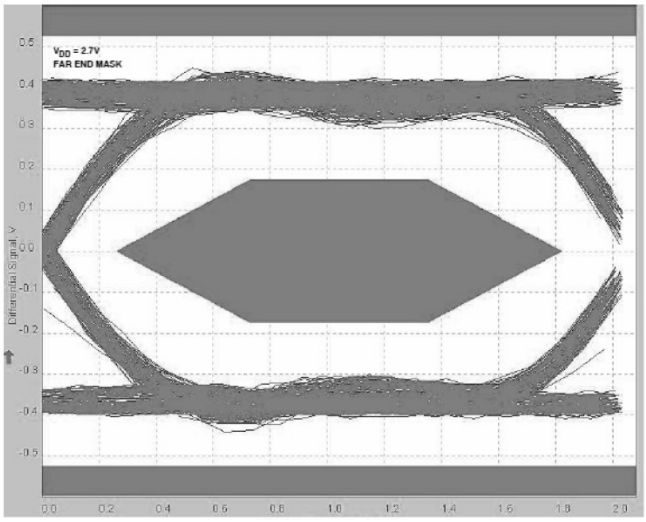
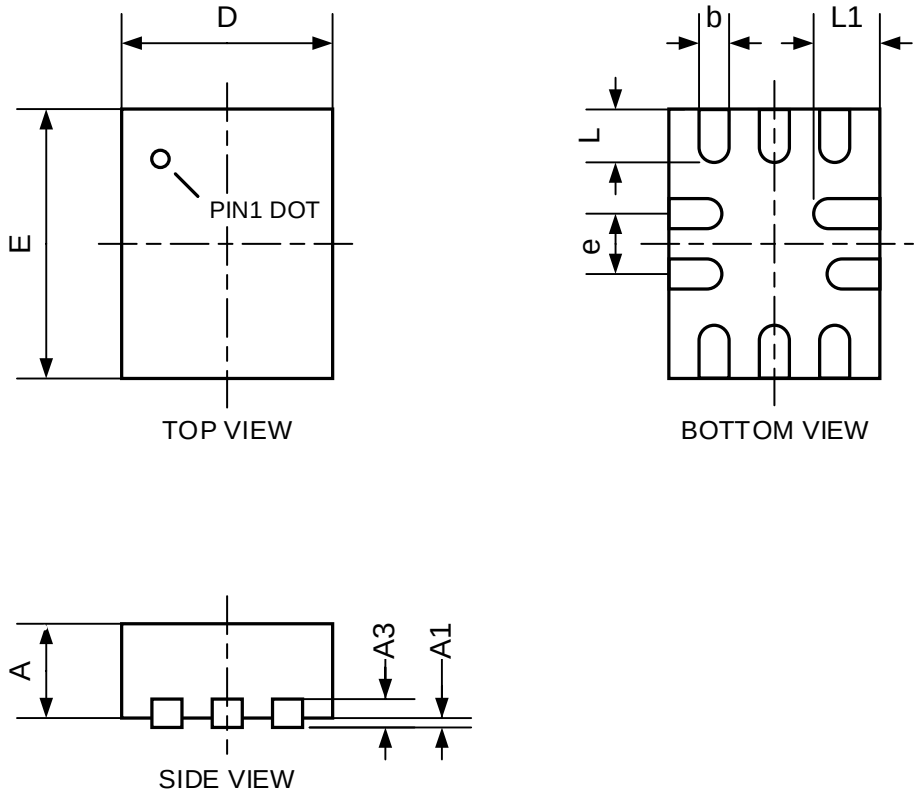


Figure7. Eye Pattern: 480Mbps with USB Switches in the Signal Path

PACKAGE OUTLINE

QFN1.8 × 1.4-10



Symbol	Dimensions In Millimeters		
	Min	Nom	Max
A	0.500	0.550	0.600
A1	0.000		0.050
A3		0.150REF	
D	1.350	1.400	1.450
E	1.750	1.800	1.850
b	0.150	0.200	0.250
L	0.300	0.400	0.500
L1	0.400	0.500	0.600
e		0.400BSC	