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

FEATURES

- **-3dB Bandwidth: 550MHz**
- **Supply Range: +1.8V to +5.5V**
- **R_{ON} is Typically 6Ω**
- **Fast Switching Times:**
  t_{ON} 20ns
  t_{OFF} 15ns
- **Break-Before-Make Switching**
- **Low Power Consumption (1μA Maximum)**
- **Rail-to-Rail Input and Output Operation**
- **Extended Industrial Temperature Range: -40°C to +85°C**
- ***Micro*SIZE PACKAGES: MSOP-10**

APPLICATIONS

- **Routes Signals for USB 1.0, 1.1, and 2.0**
- **MP3 and Other Personal Media Players**
- **Portable Instrumentation**
- **USB Switching**
- **Digital Cameras**
- **Set-Top Box**
- **Cell Phones**
- **PDAs**

DESCRIPTION

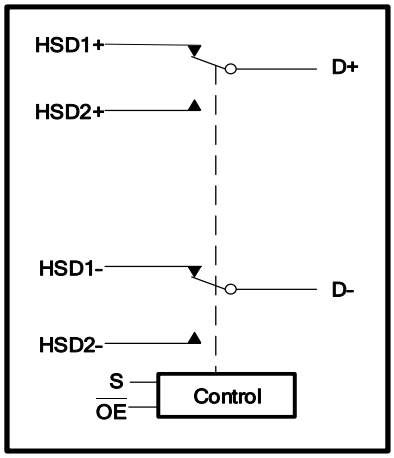
The RS2227 is a high-speed, low-power double-pole/double-throw (DPDT) analog switch with single Enable. It is designed to operate from 1.8 V to 5.5 V.

The RS2227 has a bus-switch enable pin, $\overline{OE}$, that can place the signal paths in high impedance. This allows the user to isolate the bus when it is not in use and consume less current.

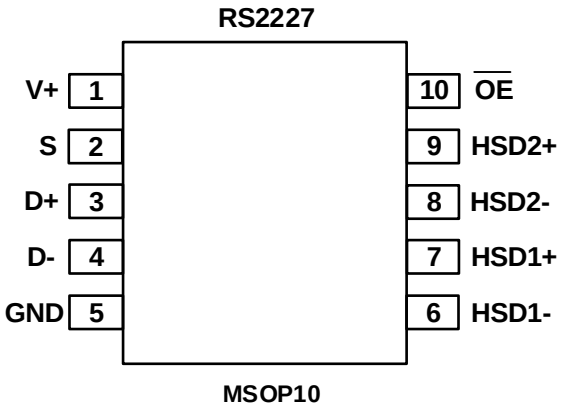
The RS2227 is a high-bandwidth switch specially designed for the switching of high-speed USB2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os.

The RS2227 is available MSOP-10 package. It operates over an ambient temperature range of -40°C to +85°C.

Functional Block Diagram



PIN CONFIGURATIONS



PIN DESCRIPTION

NAME	PIN	FUNCTION
V+	1	Power Supply
GND	5	Ground
S	2	Select Input
$\overline{OE}$	10	Output Enable
HSD1+, HSD2+	7,9	Data Port
HSD1-, HSD2-	6,8	
D+, D-	3,4	

FUNCTION TABLE

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

X =Don't care

ABSOLUTE MAXIMUM RATINGS (1)

V+ to GND	0V to 6V
Analog, Digital Voltage Range (2)	– 0.3 to (V+) + 0.3V
Continuous Current HSDn or Dn	±100mA
Peak Current HSDn or Dn	±150mA
Storage Temperature	−65°C to +150°C
Operating Temperature	−40°C to +85°C
Junction Temperature	150°C
Lead Temperature (Soldering, 10s)	260°C
ESD Susceptibility	
HBM	3000V
MM	200V

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.

ESD SENSITIVITY CAUTION

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.

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING	PACKAGE OPTION
RS2227	RS2227XN	-40°C ~+85°C	MSOP-10	RS2227	Tape and Reel,3000

ELECTRICAL CHARACTERISTICS

(V+ = +1.8V to +5.5V, GND = 0V, V_{IH} = +1.5V, V_{IL} = +0.5V, T_A = -40°C to + 85°C. Typical values are at V+ = +3.3V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	T_A	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-)	V_{IS}		-40°C to +85°C	0		V+	V
On-Resistance	R_{ON}	V+ = 3.0V, V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1	+25°C		6	10	Ω
			-40°C to +85°C			10.5	
On-Resistance Match Between Channels	ΔR_{ON}	V+ = 3.0V, V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1	+25°C		0.15	0.6	Ω
			-40°C to +85°C			1.6	Ω
On-Resistance Flatness	$R_{FLAT(ON)}$	V+ = 3.0V, V_{IS} = 0V to 1.0V, I_D = 8mA, Test Circuit 1	+25°C		5	7	Ω
			-40°C to +85°C			8	
Power Off Leakage Current (D+, D-)	I_{OFF}	V+ = 0V, V_D = 0V to 3.6 V, V_S, $V_{\overline{OE}}$ = 0V or 3.6 V	-40°C to +85°C			1	μA
Increase in I_+ per Control Voltage	I_{CCT}	V+ = 4.3V, V_S or $V_{\overline{OE}}$ = 2.6 V	-40°C to +85°C			40	μA
Source Off Leakage Current	$I_{HSD2(OFF)}$ $I_{HSD1(OFF)}$	V+ = 3.6V, V_{IS} = 3.3V/ 0.3V, V_D = 0.3V/ 3.3V	-40°C to +85°C			1	μA
Channel On Leakage Current	$I_{HSD2(ON)}$ $I_{HSD1(ON)}$	V+ = 3.6V, V_{IS} = 3.3V/ 0.3V, V_D = 0.3V/ 3.3V or floating	-40°C to +85°C			1	μA
DIGITAL CONTROL INPUTS(1)							
Input High Voltage	V_{IH}		-40°C to +85°C	1.6			V
Input Low Voltage	V_{IL}		-40°C to +85°C			0.5	V
Input Leakage Current	I_{IN}	V+ = 3.0V, V_S, $V_{\overline{OE}}$ = 0V or V+	-40°C to +85°C			1	μA

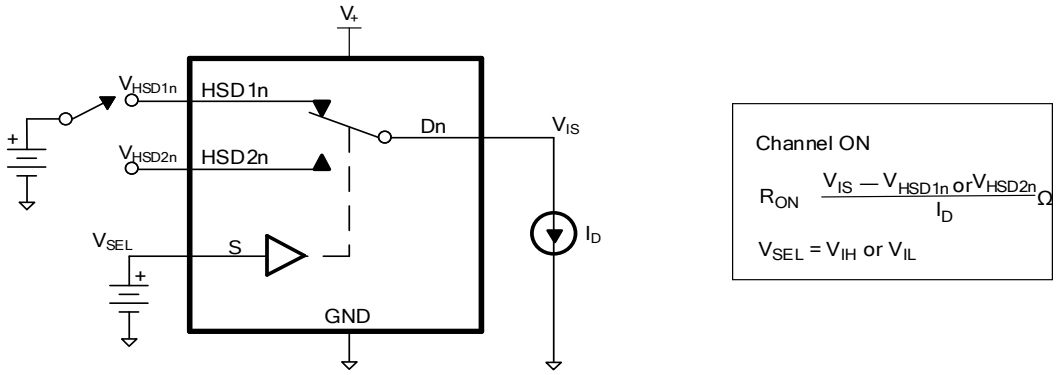
(1) All unused digital inputs of the device must be held at V_{IO} or GND to ensure proper device operation.

ELECTRICAL CHARACTERISTICS (continued)

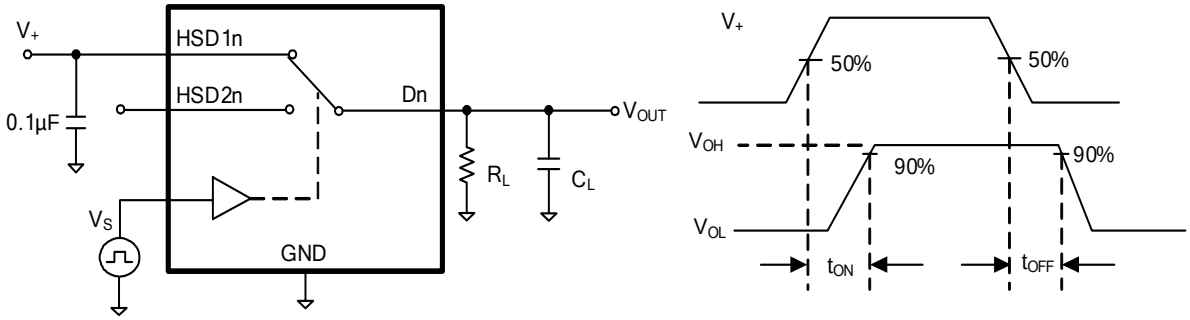
(V+ = +1.8V to +5.5V, GND = 0V, V_{IH} = +1.5V, V_{IL} = +0.5V, T_A = -40°C to + 85°C. Typical values are at V+ = +3.3V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 2	+25°C		20		ns
Turn-Off Time	t_{OFF}		+25°C		15		ns
Break-Before-Make Time Delay	t_D	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 3	+25°C		4		ns
Propagation Delay	t_{PD}	R_L = 50Ω, C_L = 10pF	+25°C		0.35		ns
Off Isolation	O_{ISO}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 4	+25°C		-35		dB
Channel-to-Channel Crosstalk	X_{TALK}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 5	+25°C		-40		dB
-3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω, C_L = 5pF, Test Circuit 6	+25°C		550		MHz
Channel-to-Channel Skew	t_{SKEW}	R_L = 50Ω, C_L = 10pF	+25°C		0.05		ns
Charge Injection Select Input to Common I/O	Q	V_G = GND, C_L = 1.0nF, R_G = 0Ω, Q = C_L x V_{OUT}, Test Circuit 7	+25°C		11		pC
HSD+, HSD-, D+, D- ON Capacitance	C_{ON}		+25°C		7		pF
POWER REQUIREMENTS							
Power Supply Range	V_+		-40°C to +85°C	1.8		5.5	V
Power Supply Current	I_+	V+ = 3.0V, V_S, $V_{\overline{OE}}$ = 0V or V+	-40°C to +85°C			1	μA

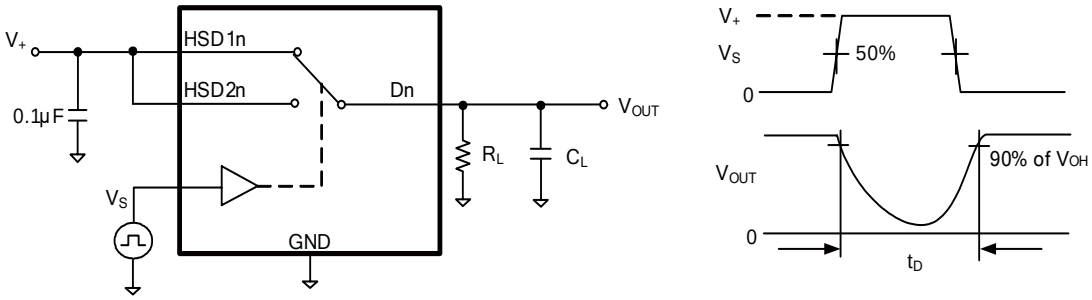
Parameter Measurement Information



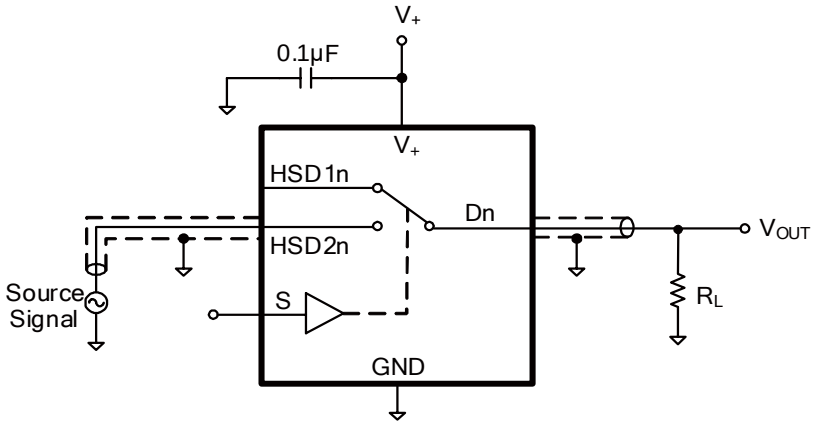
Test Circuit 1. ON-State Resistance (R_{ON})



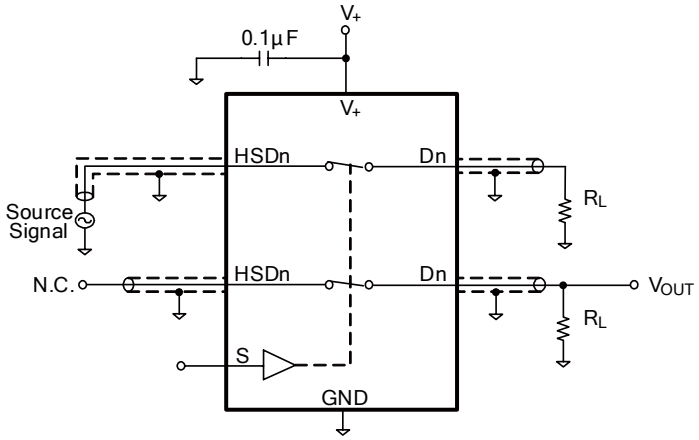
Test Circuit 2. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})



Test Circuit 3. Break-Before-Make Time (t_D)

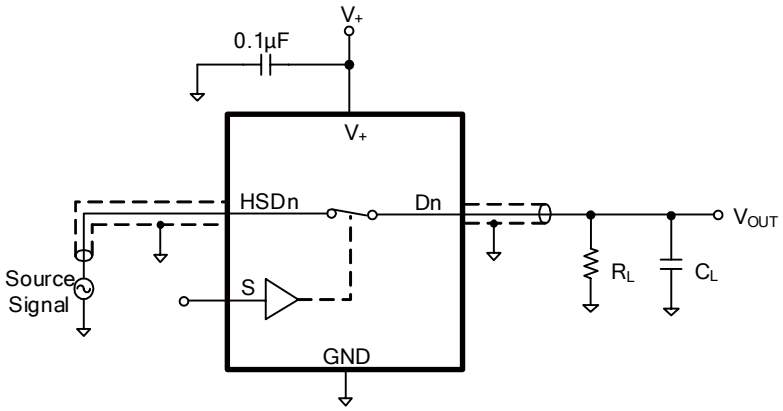


Test Circuit 4.OFF Isolation (O_{ISO})

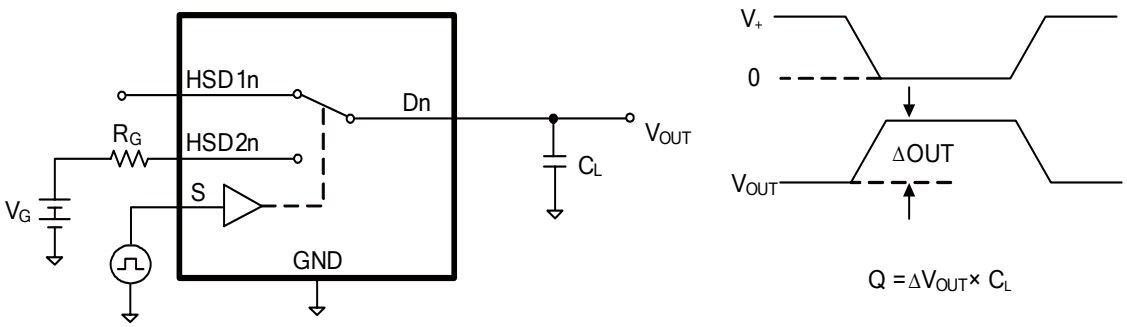


$$\text{Channel To Channel Crosstalk} = -20 \times \log \frac{V_{HSDn}}{V_{OUT}}$$

Test Circuit 5. Channel-to-Channel Crosstalk



Test Circuit 6. -3dB Bandwidth



Test Circuit 7. Charge Injection(Q)

APPLICATION NOTES

There are many USB applications in which the USB hubs or controllers have a limited number of USB I/Os. The RS2227 solution 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. RS2227 can also be used to connect a single controller to two USB connectors or controllers.

Design requirements of the USB 1.0, 1.1, and 2.0 standards should be followed. It is recommended that the digital control pins S and $\overline{OE}$ be pulled up to V+ or down to GND to avoid undesired switch positions that could result from the floating pin.

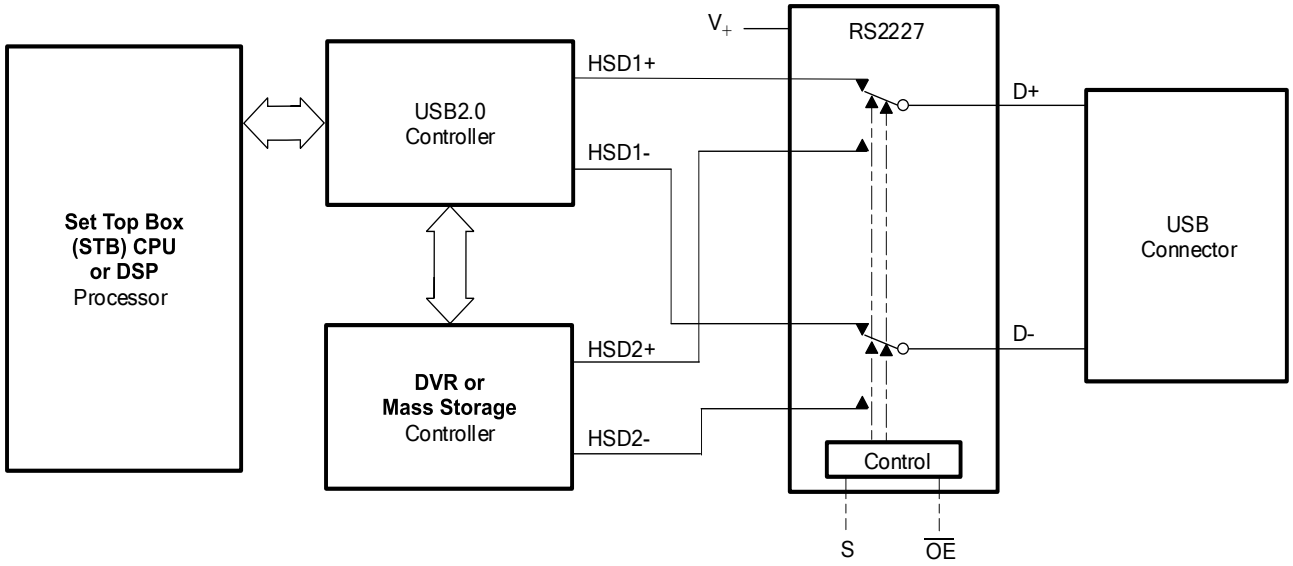
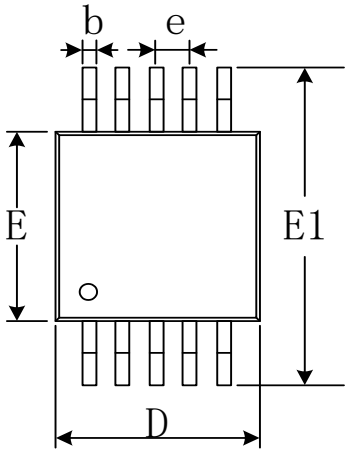
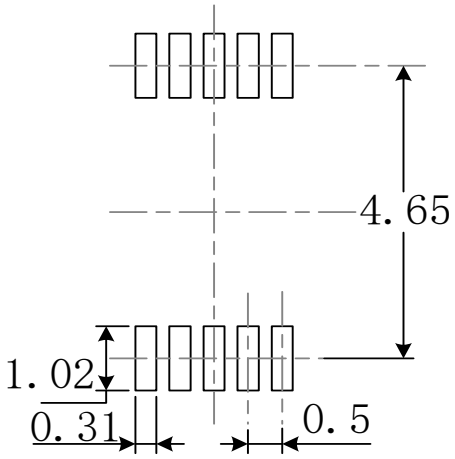


Figure 1. Application Diagram

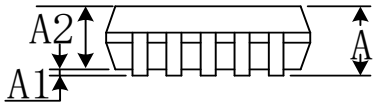
PACKAGE OUTLINE DIMENSIONS

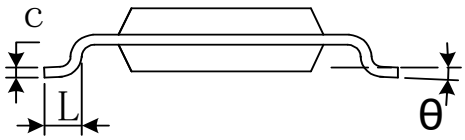
MSOP-10





RECOMMENDED LAND PATTERN (Unit: mm)





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	0.50(BSC)		0.020(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

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