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

1 FEATURES

- **-3dB Bandwidth: 720MHz**
- **Supply Range: +1.8V to +5.5V**
- **R_{ON} is Typically 6Ω**
- **Fast Switching Times:**
  t_{ON} 15ns
  t_{OFF} 5ns
- **Break-Before-Make Switching**
- **Low Power Consumption (1μA Maximum)**
- **Rail-to-Rail Input and Output Operation**
- **±8 kV HBM ESD On All Pins**
- **Power−Off Protection On Common Ports When V_{CC} = 0 V**
- **D+/D- Pins Tolerance Up to 5.5 V**
- **Extended Industrial Temperature Range: -40°C to +85°C**
- **Micro Size Packages: MSOP10, UQFN1.4X1.8-10**

2 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**

3 DESCRIPTIONS

The RS2227A 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 RS2227A 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 RS2227A 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.

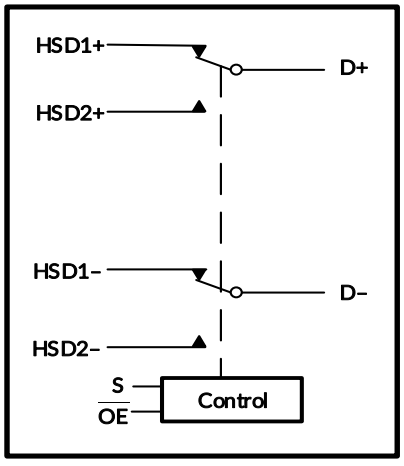
The RS2227A is available MSOP10 and UQFN1.4X1.8-10 package. It operates over an ambient temperature range of -40°C to +85°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2227A	UQFN1.4X1.8-10	1.80mm×1.40mm
	MSOP10	3.00mm×3.00mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

4 FUNCTIONAL BLOCK DIAGRAM



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5 REVISION HISTORY

Note: Page numbers for previous revisions may different from page numbers in the current version.

VERSION	Change Date	Change Item
A.0	2026/01/20	Preliminary version completed

6 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (2)	MSL (3)	PACKAGE OPTION
RS2227A	RS2227AXN	-40°C ~+85°C	MSOP10	RS2227A	MSL3	Tape and Reel, 4000
	RS2227AXUTQK10	-40°C ~+85°C	UQFN1.4X1.8-10	2227A	MSL3	Tape and Reel, 4000

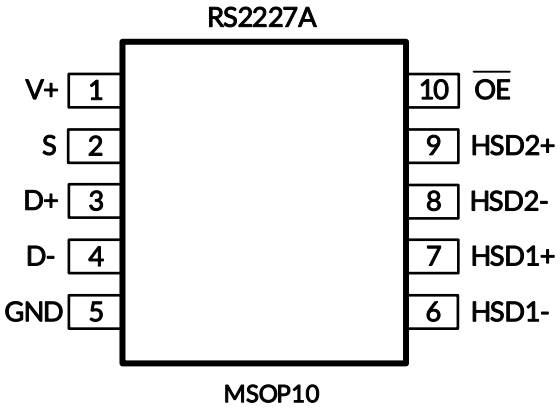
NOTE:

(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F. Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

7 PIN CONFIGURATIONS



7.1 Pin Description

NAME	PIN	FUNCTION
	MSOP10	
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	

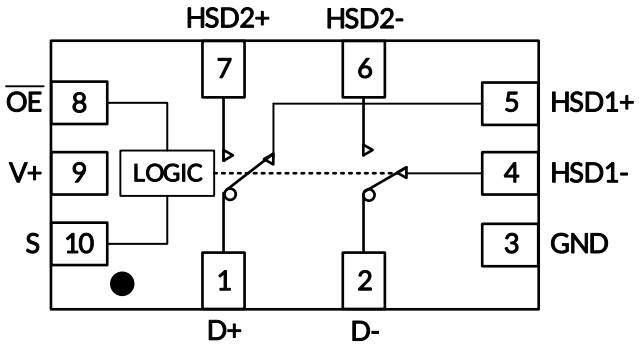
7.2 Function Table

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

Note: X =Don't care.

PIN CONFIGURATIONS

(TOP VIEW)



UQFN1.4X1.8-10

Pin Description

NAME	PIN	FUNCTION
	UQFN1.4X1.8-10	
V+	9	Power Supply
GND	3	Ground
S	10	Select Input
$\overline{OE}$	8	Output Enable
HSD1+, HSD2+	5,7	Data Port
HSD1-, HSD2-	4,6	
D+, D-	1,2	

Function Table

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

Note: X =Don't care.

8 SPECIFICATIONS

8.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_+	Supply Voltage		-0.3	6.0	V
	Analog, Digital Voltage Range (2)		-0.3	(V_+)+0.3	
	Continuous Current HSDn or Dn		-100	+100	mA
I_{PEAK}	Peak Current HSDn or Dn		-150	+150	
θ_{JA}	Package thermal impedance (3)	MSOP10		200	°C/W
		UQFN1.4X1.8-10		115	
T_J	Junction Temperature (4)		-40	150	°C
T_{stg}	Storage temperature		-65	+150	

(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.
(3) The package thermal impedance is calculated in accordance with JESD-51.
(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

8.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human Body Model (HBM), ANSI/ESDA/JEDEC JS-001-2023	±8000	V
		Charged Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2022	±1500	V

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.

8.3 Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{CC}	Supply Voltage	1.8	5.5	V
T_A	Operating temperature	-40	+85	°C

8.4 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(2)	TYP(3)	MAX(2)	UNIT
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, See Figure 1	+25°C		6	8	Ω
			-40°C to +85°C			10	
On-Resistance Match Between Channels	ΔR_{ON}	V+ = 3.0V, V_{IS} = 0V to 0.4V, I_D = 8mA	+25°C		0.08	0.2	Ω
			-40°C to +85°C			0.5	Ω
On-Resistance Flatness	$R_{FLAT(ON)}$	V+ = 3.0V, V_{IS} = 0V to 1.0V, I_D = 8mA	+25°C		1.4	2.5	Ω
			-40°C to +85°C			3.5	
Off state leakage	I_{OZ}	0 ≤ Dn, HSD1n, HSD2n ≤ 3.6V	-40°C to +85°C			±1	μA
Power Off Leakage Current (all common ports)	I_{OFF}	V_D = 0V to 3.6V, V_{CC} = 0V, See Figure 11	-40°C to +85°C			±1	μA
Increase in I_+ per Control Voltage	I_{CCT}	V+=3.6V, V_S or $V_{\overline{OE}}$ = 2.6V	-40°C to +85°C		0.5	2	μA
		V+=3.6V, V_S or $V_{\overline{OE}}$ = 1.8V			4	8	
DIGITAL CONTROL INPUTS							
Input High Voltage	V_{IH}	V+ =1.8V to 2.5V	-40°C to +85°C	1.3			V
		V+ =3V to 3.6V		1.5			V
		V+ =4.5V to 5.5V		1.7			V
Input Low Voltage	V_{IL}	V+ =1.8V to 2.5V	-40°C to +85°C			0.4	V
		V+ =3V to 3.6V				0.6	V
		V+ =4.5V to 5.5V				0.7	V
Input Leakage Current	I_{IN}		-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.
(2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

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	T_A	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{IS} = 0.8V, R_L = 50Ω, C_L = 5pF, See Figure 17	+25°C		15		ns
Turn-Off Time	t_{OFF}		+25°C		5		ns
Break-Before-Make Time Delay	t_D	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, See Figure 16	+25°C		8		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 = 240MHz, See Figure 15	+25°C		-38		dB
Channel-to-Channel Crosstalk	X_{TALK}	Signal = 0dBm, R_L = 50Ω, f = 240MHz, See Figure 14	+25°C		-35		dB
-3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω, C_L = 5pF, See Figure 13	+25°C		720		MHz
Channel-to-Channel Skew	t_{SKEW}	R_L = 50Ω , C_L = 10pF	+25°C		0.1		ns
HSD+, HSD-, D+, D- ON Capacitance	C_{ON}	V+=3.3V, $\overline{OE}$=GND, f=10MHz, See Figure 12	+25°C		6		pF
HSD+, HSD-, D+, D- OFF Capacitance	C_{OFF}	V+=$\overline{OE}$=3.3V, f=10MHz, See Figure 12	+25°C		2.5		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 or $V_{\overline{OE}}$ = 0V or V+	-40°C to +85°C			1	μA

8.5 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

T_A = 25°C, V_{CC} = 3.3 V, unless other otherwise specified.

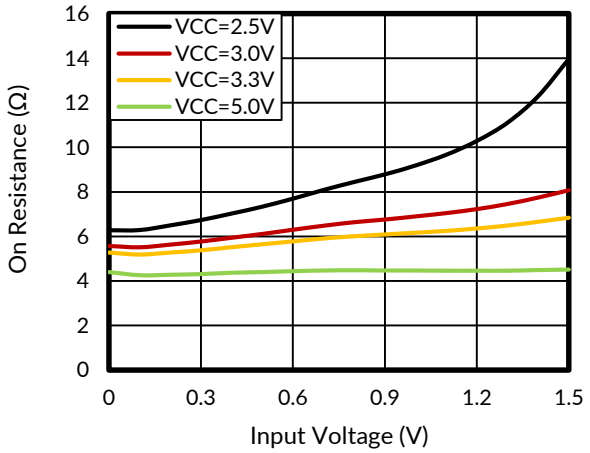


Figure 1. On Resistance vs Input Voltage

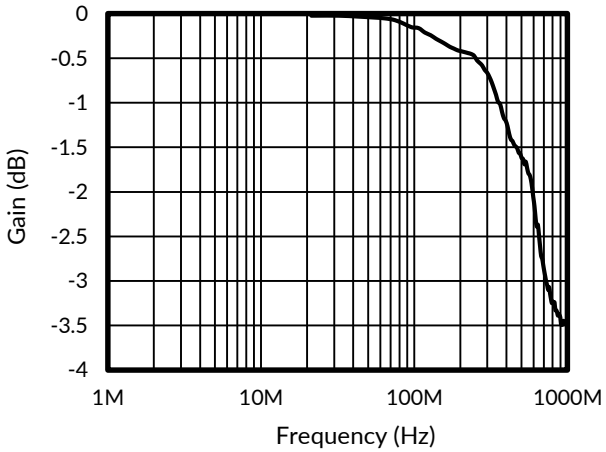


Figure 2. Gain vs Frequency

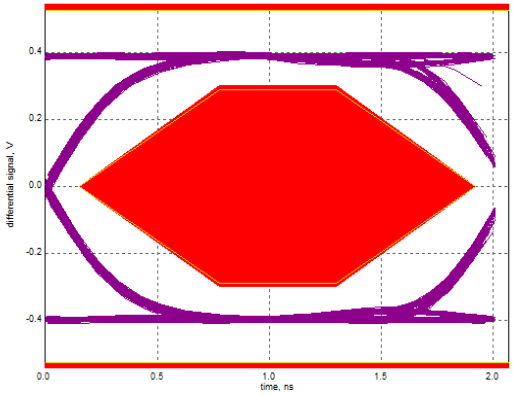


Figure 3. Eye Pattern: 480-Mbps USB Signal With No Switch (HSD1n Path)

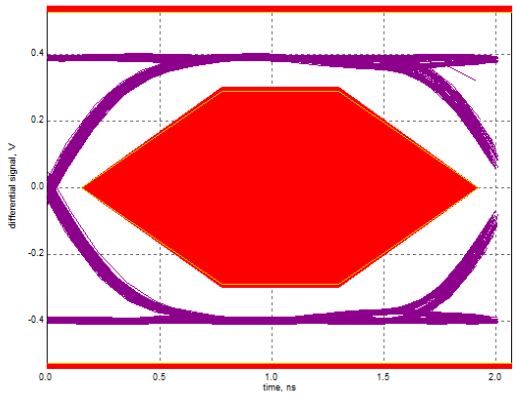


Figure 4. Eye Pattern: 480-Mbps USB Signal With No Switch (HSD2n Path)

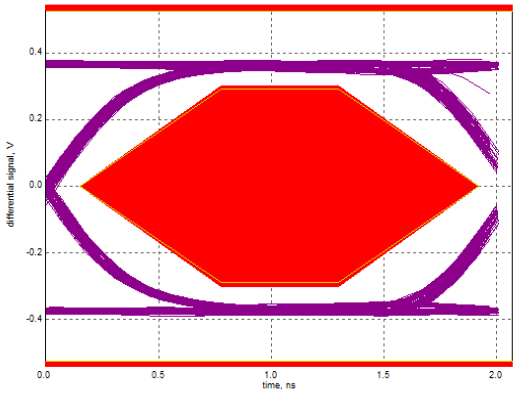


Figure 5. Eye Pattern: 480 Mbps USB Signal With HSD1n Path

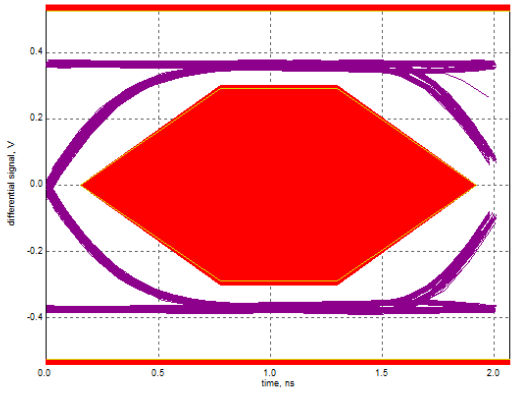


Figure 6. Eye Pattern: 480 Mbps USB Signal With HSD2n Path

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

T_A = 25°C, V_{CC} = 3.3 V, unless other otherwise specified.

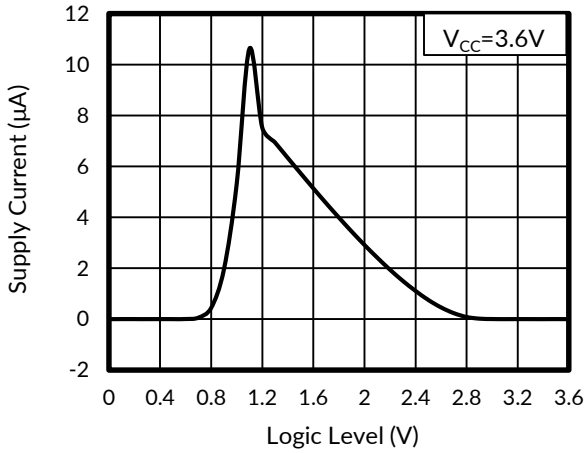


Figure 7. Supply Current vs Logic Level

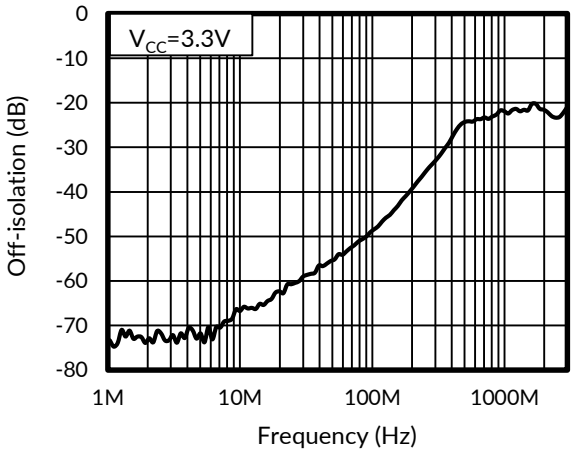


Figure 8. Off-isolation vs Frequency

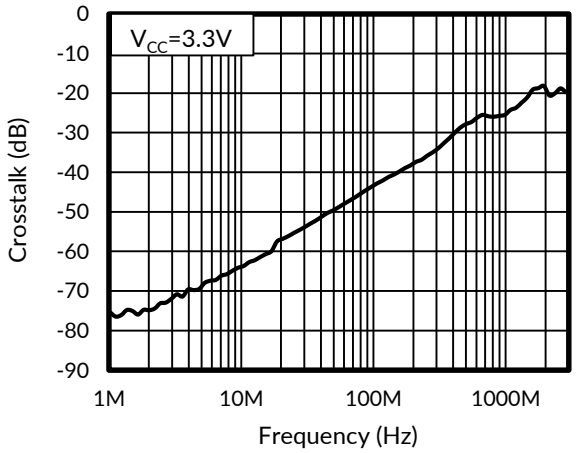


Figure 9. Crosstalk vs Frequency

9 PARAMETER MEASUREMENT INFORMATION

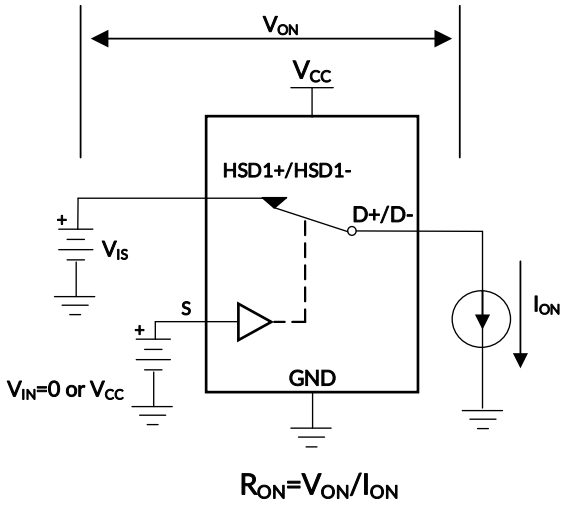


Figure 10. Switch on resistor

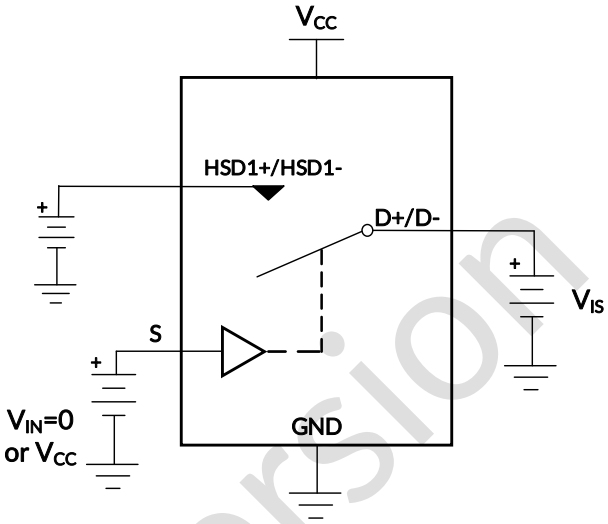


Figure 11. Switch off leakage

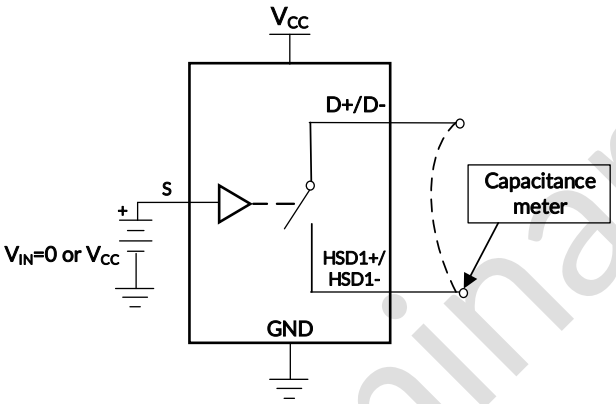


Figure 12. Channel on/off capacitance

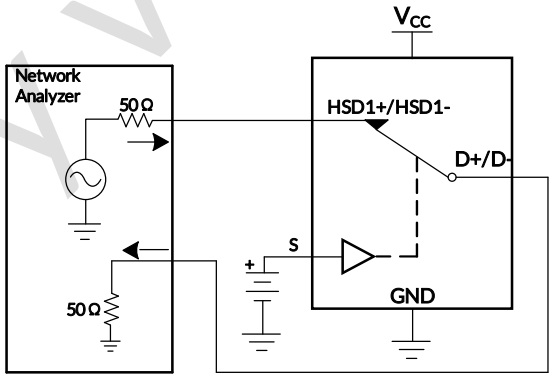


Figure 13. Bandwidth

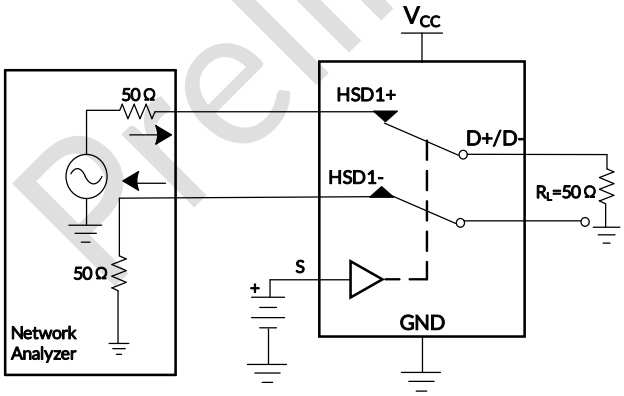


Figure 14. Channel-to-channel crosstalk

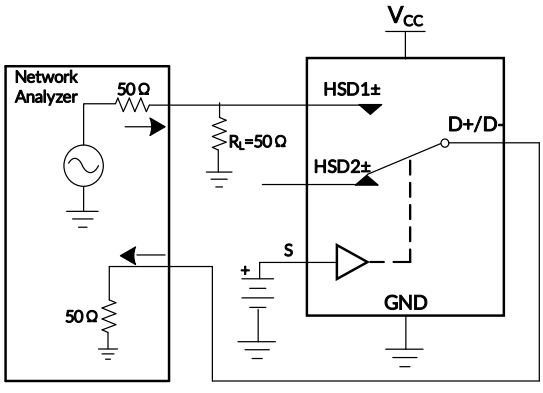


Figure 15. Off-isolation

PARAMETER MEASUREMENT INFORMATION

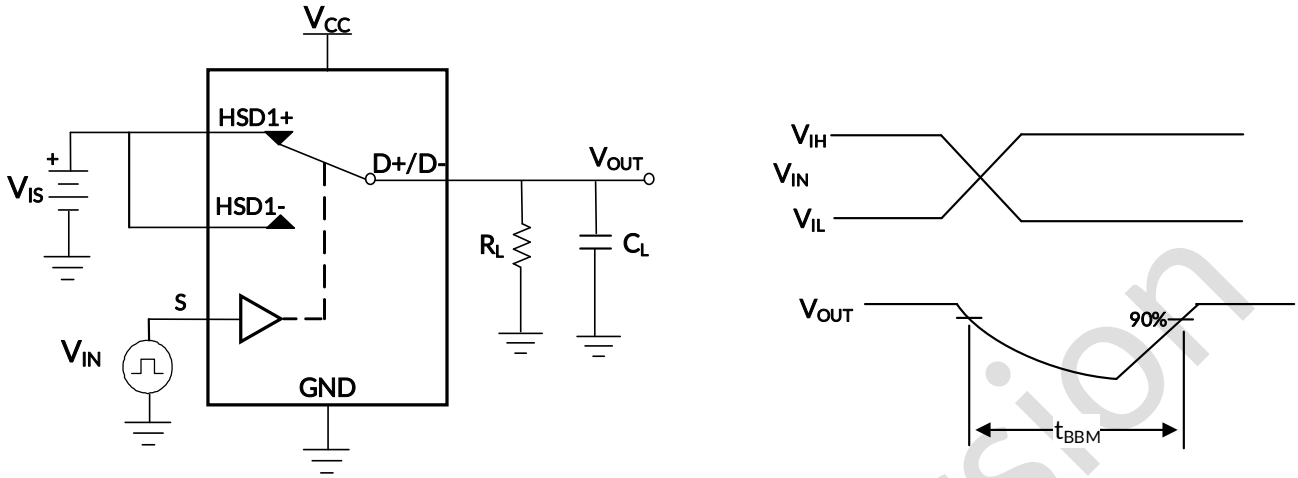


Figure 16. Break-before-make

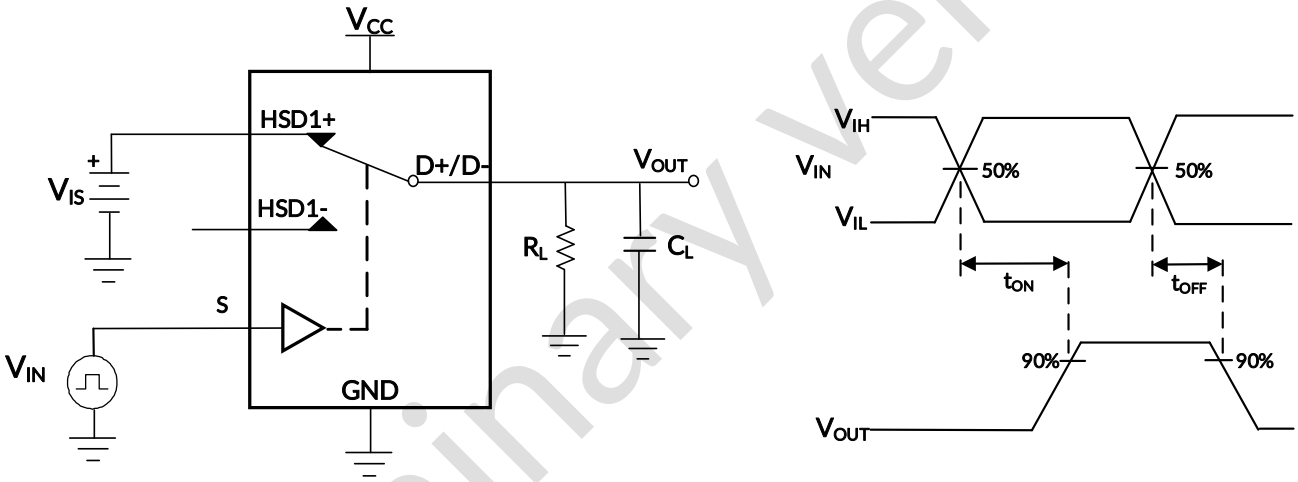


Figure 17. Turn-on / Turn-off

10 APPLICATION NOTES

There are many USB applications in which the USB hubs or controllers have a limited number of USB I/Os. The RS2227A 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. RS2227A 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.

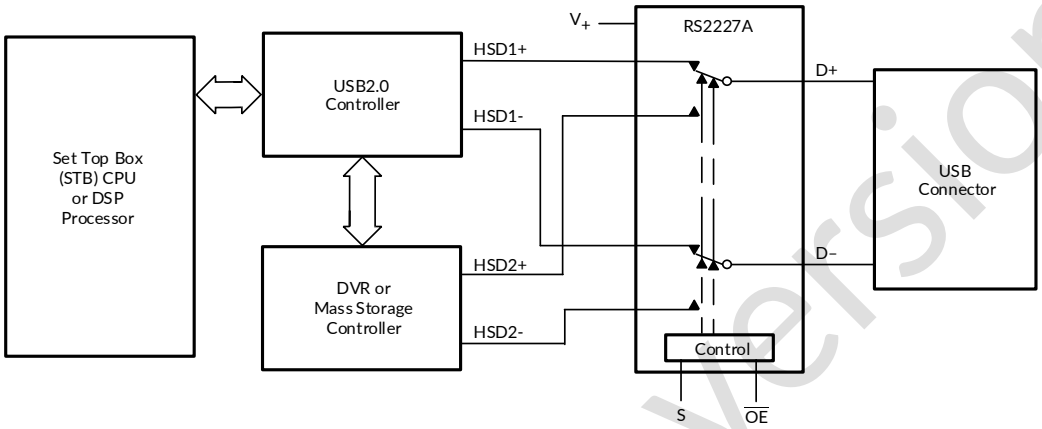
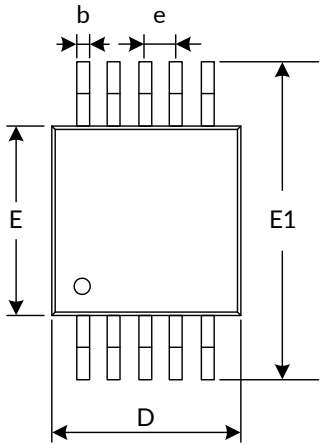
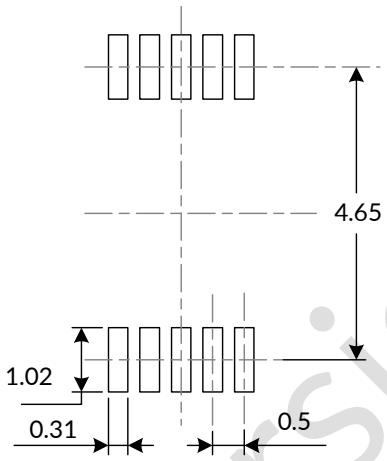


Figure 18. Application Diagram

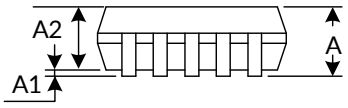
11 PACKAGE OUTLINE DIMENSIONS

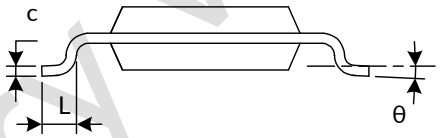
MSOP10 (3)





RECOMMENDED LAND PATTERN (Unit: mm)



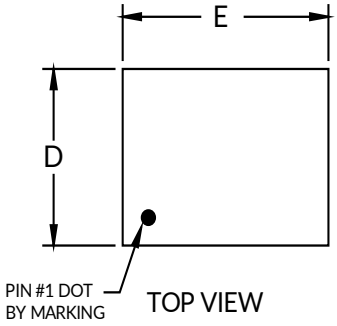


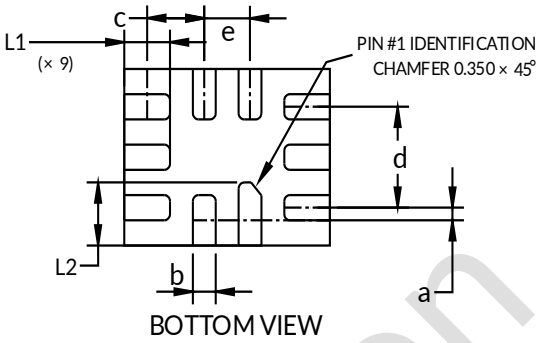
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D (1)	2.900	3.100	0.114	0.122
e	0.500(BSC) (2)		0.020(BSC) (2)	
E (1)	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

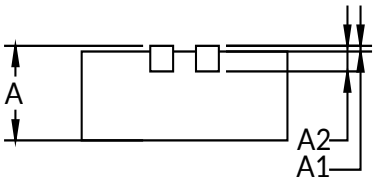
NOTE:

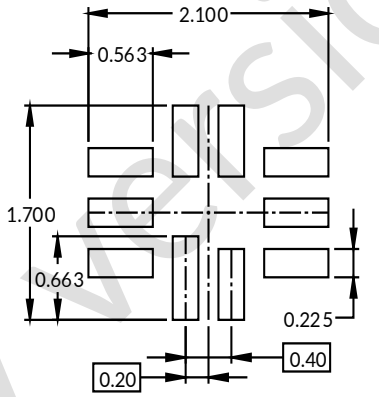
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

UQFN1.4X1.8-10 (3)









Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
A2	0.203 REF (2)		0.008 REF (2)	
a	0.050	0.150	0.002	0.006
b	0.150	0.250	0.006	0.010
c	0.450	0.550	0.018	0.022
d	0.800 REF (2)		0.031 REF (2)	
D (1)	1.350	1.450	0.053	0.057
E (1)	1.750	1.850	0.069	0.073
e	0.400 TYP		0.016 TYP	
L1	0.350	0.450	0.014	0.018
L2	0.450	0.550	0.018	0.022

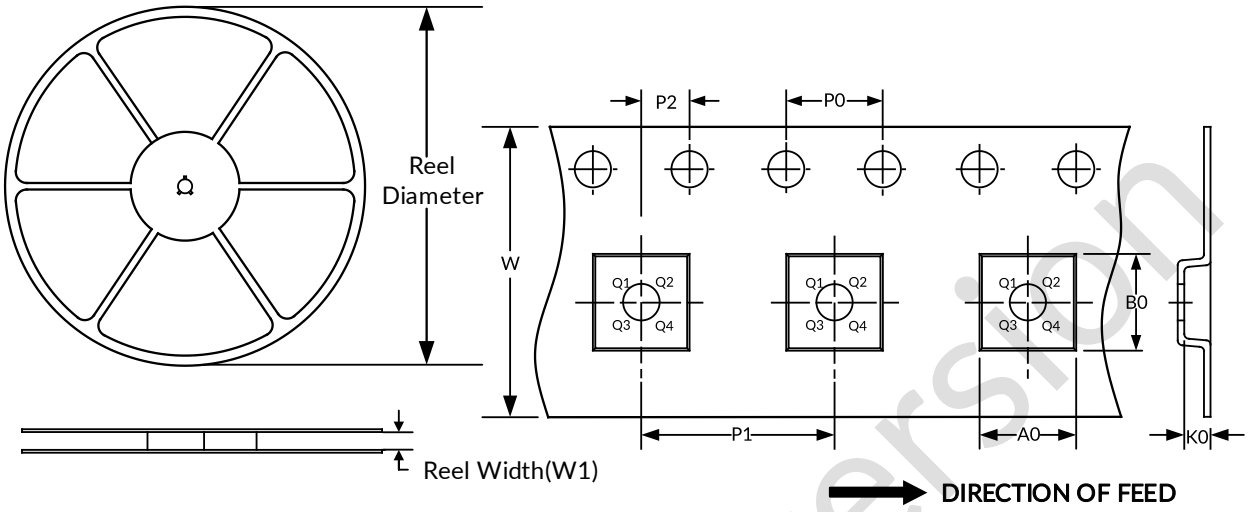
NOTE:

1. Plastic or metal protrusions of 0.075mm maximum per side are not included.
2. REF is the abbreviation for Reference.
3. This drawing is subject to change without notice.

12 TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
MSOP10	13”	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	Q1
UQFN1.4X1.8-10	7”	9.0	1.60	2.00	0.85	4.0	4.0	2.0	8.0	Q1

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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