

Features

- Device Temperature –40°C to 125°C
- VDD Operation at 1.8V, 2.5V and 3.3V
- VI/O Accepts Signals up to 5.5V
- 1.8-VCompatibleControl-PinInputs
- Low-Power Mode When OE Is Disabled (2 μA)
- rON = 6.5Ω Maximum
- ΔrON = 0.2Ω Typical
- C_{io(on)}=4pFTypical
- Support Over Voltage Protection
- Low Power Consumption (50 µA Maximum)
- ESDPerformance
 - IO Pins:
 - 12KV HBM
 - 1KV CDM
 - +/-8KV contact Discharge(IEC61000-4-2)
 - VDD, GND, S, OE Pins:
 - 4KV HBM
 - 1KV CDM
- -3dBBandwidth(1.2GHzTypical)
- Packaging (Pb-free & Green) 10-contact, UDFN (ZW10)
 - 10-contact, UQFN (ZUA10)

Applications

- Automotive USB Hubs
- Automotive Infotainment

Description

The RS3SW221Q is a high-bandwidth switch specially designed for the switching of high-speed USB 2.0 signals in automotive USB hubs or controllers with limited USB I/Os.

The wide bandwidth (1.2 GHz) of this switch allows signals to pass with minimum edge and phase distortion. The device multiplexes differential outputs from a USB host device to one of two corresponding outputs. The switch is bidirectional and offers little or no attenuation of the highspeed signals at the outputs.

It is designed for low bit-to-bit skew and high channel-tochannel noise isolation, and is compatible with various standards, such as high-speed USB 2.0 (480 Mbps).

The RS3SW221Q offer over voltage protection for the D+/D- pins as per the USB 2.0 specification. With the chip power on or off if D+/D- pins are shorted to VBUS (5V+/-5%), a less than 3.3V (typical) signal will transmit through 1D+/1D- and 2D+/2D- output.

Ordering Information

Part Number	t Number Package Descrip	
RS3SW221QZUAE	UQFN-10	1.5mm x 2.0mm
RS3SW221QZWE	UDFN-10	3mm x 3mm

Notes: E = Pb-free and Green



Block Diagram



Typical Application Diagram





Pin Configuration



Pin Description

Pin Name	Number	Description	
1D+	1	Multiplexed high speed data port 1, differential +	
1D-	2	Multiplexed high speed data port 1, differential -	
2D+	3	Multiplexed high speed data port 2, differential +	
2D-	4	Multiplexed high speed data port 2, differential -	
GND	5	Ground	
/OE	6	Active LOW, Output enable	
D-	7	Common high speed data port, differential -	
D+	8	Common high speed data port, differential +	
S	9	Select input	
VDD	10	Power supply	

Functions Table

SEL	OE	Function
Х	Н	Disconnect
L	L	D- to D1-, D+ toD1+
Н	L	D- to D2-, D+ to D2+



Absolute Maximum Ratings (1)

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

V _{DD} Supply Voltage Range0.5V to 4.6V
V _{IN} Control Input Voltage Range ^(2, 3) 0.5V to 5.5V
V _{I/O} Switch I/O Voltage Range ^(2, 3, 4) 0.5V to 5.5V
I_{IK} Control Input Clamp Current ($V_{IN} < 0$)
I _{I/OK} I/O Port Clamp Current ($V_{I/O} < 0$)
I _{I/O} ON-state Switch Current ⁽⁵⁾ ±120mA
Continuous Current through V_{DD} or GND
TLLGA Package
TDFN Package
T _{stg} Storage Temperature Range65 to 150°C
Tj Junction Temperature

Notes:

- 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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- 2. All voltages are with respect to ground, unless otherwise specified.
- 3. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- 4. VI and VO are used to denote specific conditions for VI/O.
- 5. II and IO are used to denote specific conditions for II/O.
- 6. The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions ⁽¹⁾

Symbol	Description	Parameter	MIN	MAX	Unit
V _{DD}	Supply voltage		1.62	3.63	
V	High-level control input voltage	V _{DD} = 2.3 V to 2.7 V	1.3	-	V
VIH		V _{DD} = 2.7 V to 3.6 V	1.4	-	
VIL	Low-level control input voltage	V _{DD} = 2.3 V to 2.7 V		0.6	
		V _{DD} = 2.7 V to 3.6 V		0.6	
V _{I/O}	Data input/output voltage		0	4.6	
TA	Operating free-air temperature		-40	125	°C

Note:

1. All unused control inputs of the device must be held at V_{DD} or GND to ensure proper device operation.



Electrical Characteristics

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

Р	arameter	Testing Condition	ons	MIN	ТҮР	MAX	Unit
Viк		VDD = 3.6V, 1.8V, I _I = -18 mA				-1.2	V
lin	Control Inputs	VDD = 3.6V,1.8V	VDD = 3.6V,1.8V, 0V, VIN = 0V to 3.6V			±1	
loz (3)		VDD = 3.6V, 1.8V VO = 0V to 3.6V,	VDD = 3.6V, 1.8V, VIN = VDD or GND, VO = 0V to 3.6V, VI = 0V, Switch OFF			±1	
			VI/O = 0V to 3.6V			±2	1
		VDD - 0V	VI/O = 0 to 2.7V			±1	
Icc		VDD = 3.6V, 1.8 ON or OFF	/, VIN = VDD or GND,II/O = 0 V, Switch		25	50	- uA
ICC (low	w power mode)	VDD = 3.6V <u>, 1</u> .8V (OE=high)	/, VIN = VDD or GND,Switch disabled,			4	
DIcc	Control	VDD=3.6V,1.8V	SEL sweeps from 1.4V to 3.3V, /OE = 0V			15	
(3)	Inputs		OE/ sweeps from 1.4V to 3.3V, SEL = 0V			0.75	
CIN	Control Inputs	VDD = 3.3V, 1.8V	VDD = 3.3V, 1.8V, VIN = 3.3V or 0V		1	2	
Cio(OFF)		VDD = 3.3V, 1.8V, VIN = 3.3V or 0V, Switch OFF			2	3	pF
Cio(ON)		VDD = 3.3V, 1.8V, VIN = 3.3V or 0V, Switch ON			4	6	
ma(E)			VI = 0V, IO = 30 mA			4	
ron(5)		VDD = 3V, 1.8V	VI = 2.4V, IO = -15 mA			6.5	Ω
		VDD = 3V, 1.8V	VI = 0V, IO = 30 mA		0.2		
DrON(6)	VI = 1.7V, IO = -15 mA			0.2			
ron(flat)			VI = 0V, IO = 30 mA		1		
		עט = 3V, 1.8V	VI = 1.7V, IO = -15 mA		1		
Vpass		VDD = 1.8-3.3V	VIN > 3.8V, IO = 10uA	3.0	3.3	3.6	V

Notes:

1. VIN and IIN refer to control inputs. VI, VO, II, and IO refer to data pins.

2. All typical values are at VDD = 3.3 V (unless otherwise noted), TA = 25°C.

3. For I/O ports, the parameter IOZ includes the input leakage cur

- 4. This is the increase in supply current for each input that is at the specified TTL voltage level, rather than VDD or GND.
- 5. Measured by the voltage drop between the input and output terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two terminals.



6. Dron is delta Ron between channels

Dynamic Electrical Characteristics

Over operating range, $T_A = -40^{\circ}$ C to 125°C, $V_{DD} = 3.3 \text{ V} \pm 10\%$, GND = 0V

Symbol	Parameter	Test Conditions	TYP(1)	Unit
XTALK	Crosstalk	RL = 50Ω, <i>f</i> = 250 MHz	-38	dB
OIRR	OFF isolation	RL = 50Ω, <i>f</i> = 250 MHz	-40	dD
BW	Bandwidth (–3 dB)	RL = 50Ω	1.2	GHz

Note:

1. For Max or Min conditions, use the appropriate value specified under Electrical Characteristics for the applicable device type.

Switching Characteristics

Over operating range, $T_A = -40^{\circ}$ C to 125° C, $V_{DD} = 3.3$ V ± 10%, GND = 0V

Symbol	Parameter	MIN	TYP (1)	МАХ	Unit	
tpd	Propagation Delay (2,3)			0.25		
tON	l inc onchio timo	SEL to D, 1D,2D			125	
		OE to D, 1D,2D			100	
tOFF	Line disable time	SEL to D, 1D,2D			12	
		OE to D, 1D,2D			12	
tSK(O)	Output skew between center port to any other port(2)			0.1	0.2	ns
tSK(P)	Skew between oppo (tPHL – tPLH)(2)		0.1	0.2		
tVPASS	OVP response time			53		

Notes:

- 1. For Max or Min conditions, use the appropriate value specified under Electrical Characteristics for the applicable device type.
- 2. Specified by design
- 3. The switch contributes no propagational delay other than the RC delay of the on resistance of the switch and the load capacitance. The time constant for the switch alone is of the order of 0.25 ns for 10-pF load. Since this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propaga- tional delay to the system. Propagational delay of the bus switch, when used in a system, is determined by the driving circuit on the driving side of the switch and its interactions with the load on the driven side.



Application Information



Figure 1: HS Eye Test Setup

Test Result: High-speed, Up-stream,



Test Result



Parameter Measurement Information



⁽¹⁾ All input pulses are supplied by generators having the following characteristics: PRR =10 khz, t_r <=5 ns, t_f <=5 ns.

 $^{(2)}\ C_L$ includes probe and jig capacitance.

Figure 2. Turn-On (ton) and Turn-Off Time (toFF)



Figure 3. OFF Isolation (OISO)





Figure 4. Crosstalk (X_{TALK})



Figure 5. Bandwidth (BW)



Figure 6. Propagation Delay









Figure 8. ON-State Resistance (ron)









Figure 10. Capacitance



Package Information

10-UDFN (ZW)





10-UQFN (ZUA)





Revision History

Revision	Description	Date
1.0	Initial release	2024/10/29