Vaishali Semiconductor

VS32X245 / VS32X2245
High Speed CMOS VSwitch
16-Bit Bus Switches

Applications

- 5V to 3.3V translation in mixed-supply environment
- Hot-swap interface
- Logic replacement
- Bus isolation

General Description

The VS32X245 and VS32X2245 are high-speed TTL-compatible 16-bit bus switches in a flow-through pinout. Each device contains two banks of 8-bit switches with a common active-LOW enable (/OEx) for each bank. The low ON resistance of the VS32X245 allows inputs to be connected to outputs, without adding propagation delay and without generating additional signal noise. The VS32X2245 has 25Ω resistors in series with the switches to reduce ground-bounce noise from the driving source and signal reflection.

The VS32X245 and VS32X2245 bus switches are function and pinout compatible with QS32X245 and QS32X2245 switches. They enable 5V to 3.3V translation when used with a diode in the power supply line. In addition, the high off-isolation in the 'disable' mode makes these switches ideal interface elements for hot-swap applications.

Features

- Enhanced N-FET with no DC path to V_{CC} or GND in normal operating signal voltage range.
- Low impedance bidirectional data flow: 5Ω (VS32X245) and 25Ω (VS32X2245)
- Pin-compatible with QS32X245 and QS32X2245 switches.
- Near-zero propagation delay
- Zero added ground bounce or signal noise
- TTL-compatible control signals
- Undershoot clamp diodes on all switch and control pins
- ESD rating >2000V (Human Body Model) or >200V (Machine Model)
- Latch-up current >100mA
- Available in 150-mil wide 40 pin QSOP package

### Figure 1. Functional Block Diagram
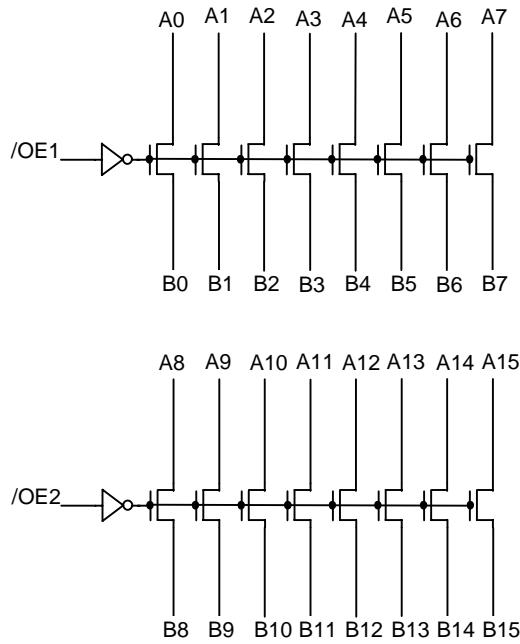
Figure 2. Pin Configuration

QSOP

(All Pins Top View)
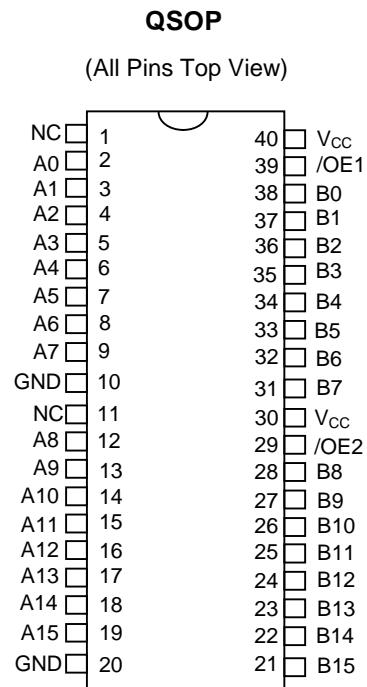
Table 1. Pin Description

Name	I/O	Description
$A_0 - A_{15}$	I/O	Bus A – Data Input or Output
/OE1, /OE2	I	Output enable
$B_0 - B_{15}$	I/O	Bus B – Data Output or Input

Table 2. Function Table

/OE1	/OE2	A0 - A7	A8 – A15	Function
H	H	Hi - Z	Hi - Z	Disconnect
L	H	B0 – B7	Hi - Z	Connect
H	L	Hi - Z	B8 – B15	Connect
L	L	B0 – B7	B8 – B15	Connect

Table 3. Absolute Maximum Ratings

Supply Voltage to Ground……………………….…...-0.5V to +7.0V

DC Switch Voltage V_S…………………….………….-0.5V to +7.0V

DC Input Voltage V_{IN}………………………………… ...-0.5V to +7.0V

AC Input Voltage (Pulse Width < 20ns)…………….….………-3.0V

DC Output Sink Current per Switch Pin………………...…..120 mA

Maximum Power Dissipation……………………….…..0.92 Watts

Storage Temperature………………………….....-65°C to +150°C

Note ABSOLUTE MAXIMUM CONTINUOUS RATINGS are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Correct functional operation while operating in the absolute maximum rated conditions is not implied.

Table 4. Capacitance

$T_A = 25^oC$, f = 1 MHz, $V_{IN} = 0V$, $V_{OUT} = 0V$

Pins	QSOP		Unit
	Typ	Max	
Control Inputs	4	5	pF
VSwitch Channels (Switch OFF)	5	7	pF

Note Capacitance is guaranteed, but not production tested. Total capacitance of a path, when the switch is closed, is the sum of the switch terminal capacitances.

Table 5. Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{CC}	Power supply voltage		4.5		5.5	V
V_{IL}	Low level input voltage		-0.5		0.8	V
V_{IH}	High level input voltage		2.0		5.5	V
T_A	Operating free-air temperature		-40		85	^{o}C

Table 6. Electrical Characteristics Over Recommended Operating Free-air Temperature Range

Symbol	Parameter	Test Conditions			Min	Typ[1]	Max	Units
V_{IK}	Clamp Voltage	Control Input	V_{CC} = Min, I_{IK} = -18 mA				-1.5	V
		Switch I/O					-1.5	
V_{OH}	Logic High Voltage	Switch I/O	V_{IN} = V_{CC} = 5V, I_{OUT} = -5μA		3.7	3.9	4.1	V
			V_{CC} = 4.3V, V_{IN} = 5V, I_{OUT} = -5μA		3.0	3.3	3.6	
$|I_I|$	Input Leakage Current	Control Input	V_{CC} = Max, V_I = V_{CC} or GND				1	μA
$|_{OFF}|$	Power OFF Leakage Current	Control Input	V_{CC} = 0, V_I or V_O = V_{CC} or GND				1	μA
		Switch I/O						
$|I_{OZ}|$	OFF State Leakage Current	Switch I/O	V_{CC} = Max, $V_{I/O}$ = V_{CC}, /OE = V_{CC}				1	μA
I_{ODL}	Switch I/O Drive Current (Logic LOW)	V_{CC} = Min, V_{IN} = 0, V_{OUT} = 0.4V	VS32X245		50			mA
			VS32X2245					mA
I_{ODH}	Switch I/O Drive Current (Logic HIGH)	V_{CC} = Min, V_{IN} = V_{CC}, V_{OUT} = 2.4V	VS32X245		-50			mA
			VS32X2245					mA
R_{ON}	Switch ON Resistance[2]	V_{CC} = Min, V_{IN} = 0, I_{OUT} = 30mA	VS32X245			5	7	Ω
			VS32X2245		20	28	40	Ω

Notes:
1. Typical values are specified at V_{CC} = 5.0V and T_A = 25°C.
2. R_{ON} is measured by forcing specified current into the 'output' node of the switch with the 'input' node of the switch at the the specified voltage

Table 7. Power Supply Characteristics Over Recommended Operating Free-air Temperature Range

Symbol	Parameter	Test Conditions [1]	Max	Units
I_{CCQ}	Quiescent Power Supply Current	V_{CC} = Max, /OE = V_{CC} or GND, f = 0	6	μA
ΔI_{CC}	Power Supply Current per Input High (Control Input) [2]	V_{CC} = Max, V_{IN} = 3.4V, f = 0	1.5	mA
Q_{CCD}	Dynamic Power Supply Current [3]	V_{CC} = Max, Switch pins open, Control Inputs toggling at 50% duty cycle	0.25	mA/MHz

Notes:
1. For conditions shown as Min or Max, use the appropriate values per *Recommended Operating Conditions*.
2. Per TTL-driven control input. All other control inputs at GND. Switch I/O pins do not contribute to ΔICC.
3. This parameter represents the average DC current resulting from the switching of internal nodes of the device at a given frequency. The switch I/O pins make insignificant contribution to the dynamic power supply current of the device. This parameter is guaranteed, but not production tested.

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Figure 3. VOLTAGE TRANSLATION

Vout

(V)

VCC = 4.3V

Vin (V)
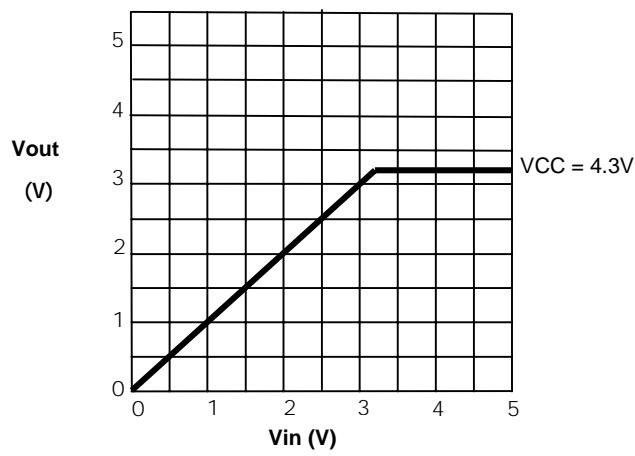
Figure 4. VOH CHARACTERISTICS

TA = 85°C
TA = 25°C
TA = - 40°C

**VOH
Output Voltage
(V)**

VCC – Supply Voltage (V)
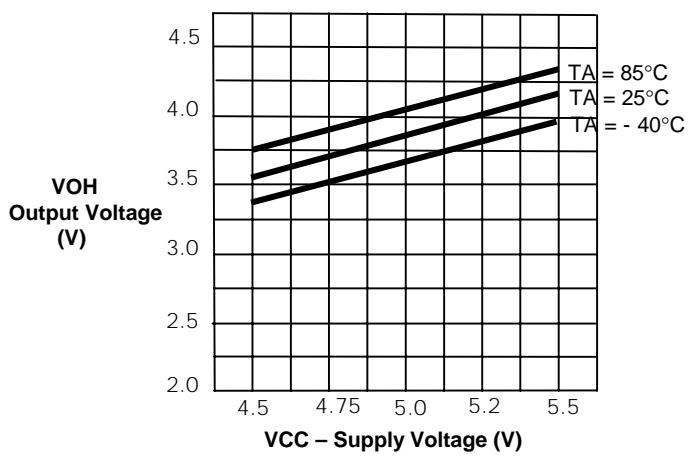
Figure 5. Voltage Translation Application

V_{CC} = 5V

1N4148
or equivalent

10K

V_{CC}

5V
DEVICE

I/O

I/O

3.3V
DEVICE

VS32X245
VS32X2245

/OE$_X$

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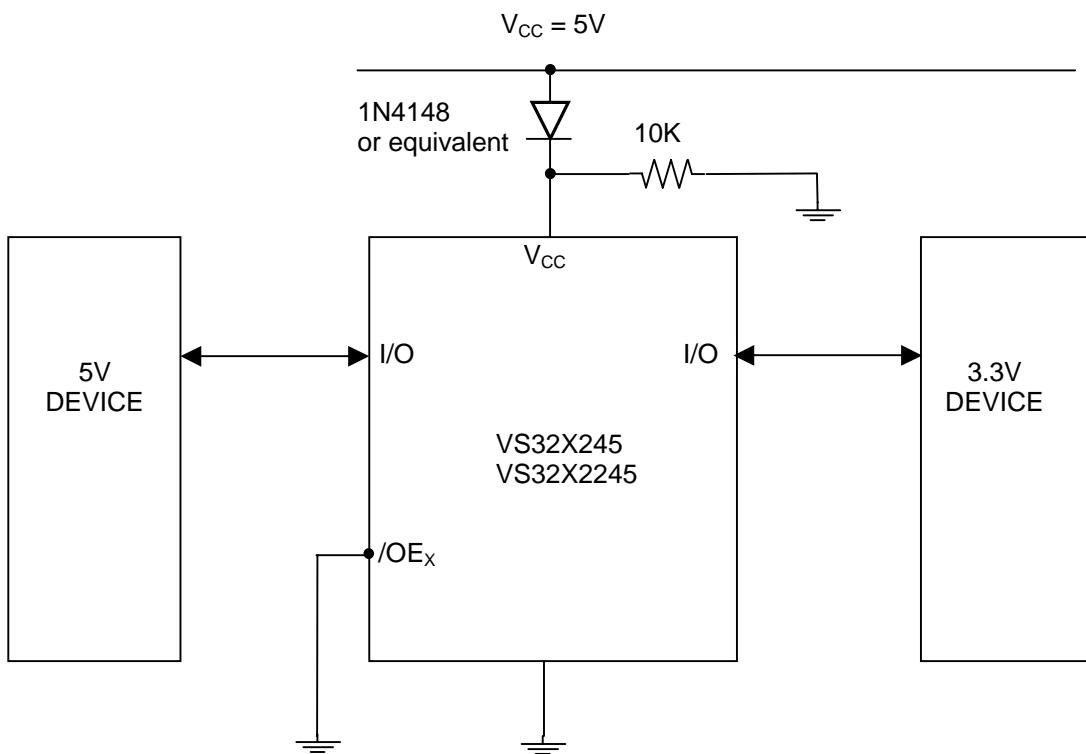
Table 8. Switching Characteristics Over Operating Range

T_A = -40°C to +85°C, V_{CC} = 5.0V ± 10%
C_{LOAD} = 50pF, R_{LOAD} = 500Ω unless otherwise stated.

Symbol	Description [1]	VS3245		VS32245		Units
		Min[3]	Max	Min[3]	Max	
t_{PLH}, t_{PHL}	Data Propagation Delay [2,3] through the switch		0.25		1.25	ns
t_{PZH}, t_{PZL}	Switch Turn-on Delay, /OE_X to A_n, B_n	0.5	5.6	0.5	6.6	ns
t_{PLZ}, t_{PHZ}	Switch Turn-off Delay /OE_X to A_n, B_n	0.5	4.5	0.5	4.5	ns

Notes:

1. See test circuits and waveforms.
2. This parameter is the calculated theoretical RC time constant of ON-state resistance of the switch and the specified load capacitance when driven by an ideal voltage source (zero source impedance). This time-constant is on the order of 0.25 ns for VS32X245 and 1.25 ns for VS32X2245. Since this time-constant is much smaller than rise/fall times of typical driving signals, it adds very little propagation delay to the system.
3. This parameter is guaranteed, but not production tested.

## Figure 6. AC Test Circuit and Switching Waveforms

AC Test Circuit
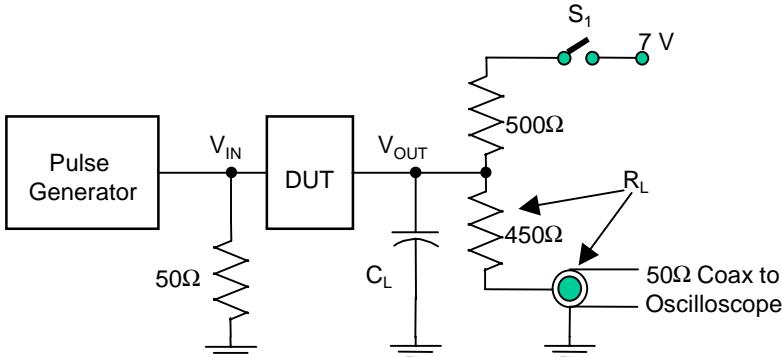
Load Switch Position

| TEST	S1
t_{PLH}, t_{PHL}	Open
t_{PLZ}, t_{PZL}	Closed
t_{PHZ}, t_{PZH}	Open

Input Conditions

Input voltage = 0 V to 3.0 V
t_r = t_f = 2.5ns (10% to 90%)

Switching Waveforms
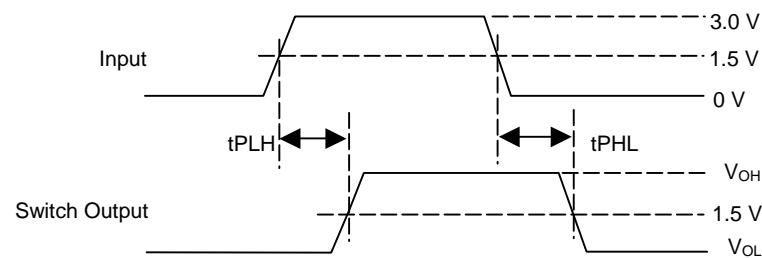
Propagation Delay
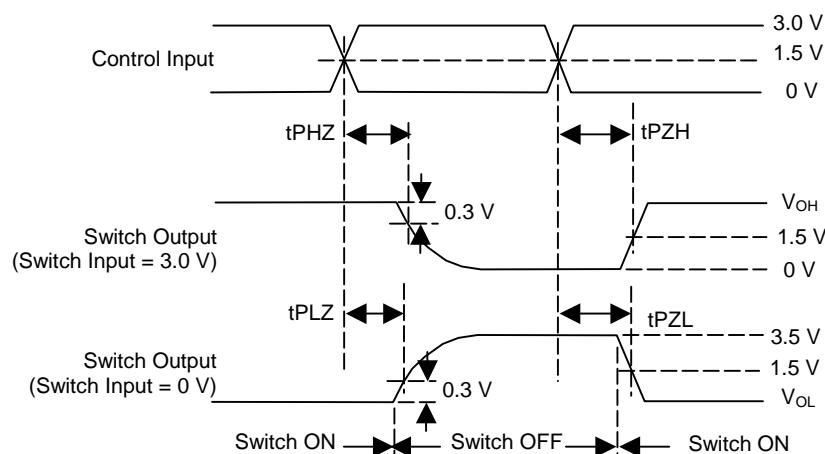
Enable and Disable Times

Ordering Information

Part Number	No. of Pins	Package	Temperature
VS32X245Q2	40	QSOP	-40°C to +85°C
VS32X2245Q2	40	QSOP	-40°C to +85°C