

Applications

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

General Description

The VS3244 and VS32244 are high-speed TTL-compatible dual 4-bit bus switches. The VS3244 contains two banks of 4-bit switches, with one common active low enable (/G) per bank. The low ON resistance of the VS3244 allows inputs to be connected to outputs, without adding propagation delay and without generating additional signal noise. The VS32244 has 25Ω resistors in series with the switches to reduce ground-bounce noise and signal reflection.

The VS3244 and VS32244 bus switches are function and pinout compatible with QS3244 and CBT3244 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 VS3244 and VS32244 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 (VS3244) and 25Ω (VS32244)
- Pin-compatible with QS3244 and CBT3244 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- Available in 150-mil wide QSOP package

Figure 1. Functional Block Diagram

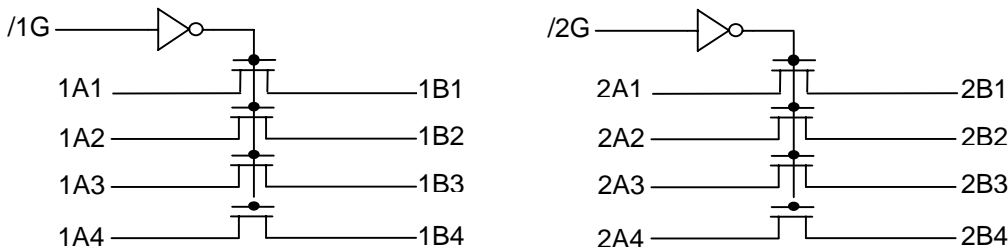


Figure 2. Pin Configuration
(All Pins Top View)
QSOP

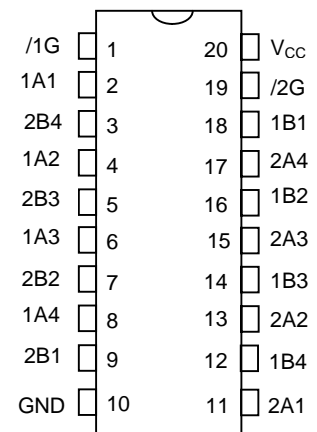


Table 1. Pin Description

Name	I/O	Description
1A1 – 1A4 2A1 – 2A4	I/O	Data Input or Output
/1G, /2G	I	Enable Input
1B1 – 1B4 2B1 – 2B4	I/O	Data Output or Input

Table 2. Function Table (Each 4-bit bus switch)

Input	Path	Function
/nG		
H	Hi Impedance	Disable all switches
L	Switch Closed	A port = B port

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.....	0.5 Watts
Storage Temperature.....	-65°C to +150°C

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

$T_A = 25^\circ\text{C}$, $f = 1\text{ MHz}$, $V_{IN} = 0\text{V}$, $V_{OUT} = 0\text{V}$

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	°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 _N = 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
I _{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} , /1G, /2G = V _{CC}			1	μA
I _{ODL}	Switch I/O Drive Current (Logic LOW)	V _{CC} = Min, V _{IN} = 0, V _{OUT} = 0.4V	VS3244	50			mA
			VS32244				mA
I _{ODH}	Switch I/O Drive Current (Logic HIGH)	V _{CC} = Min, V _{IN} = V _{CC} , V _{OUT} = 2.4V	VS3244	-50			mA
			VS32244				mA
R _{ON}	Switch ON Resistance ⁽²⁾	V _{CC} = Min, V _{IN} = 0, I _{OUT} = 30mA	VS3244		5	7	Ω
			VS32244	20	28	40	Ω

Notes:

- Typical values are specified at V_{CC} = 5.0V and T_A = 25°C.
- R_{ON} is measured by forcing specified current into the 'output' node of the switch with the 'input' node of the switch at 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, /1G, /2G = V _{CC} or GND, f = 0	1	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:

- For conditions shown as Min or Max, use the appropriate values per *Recommended Operating Conditions*.
- Per TTL-driven control input. All other control inputs at GND. Switch I/O pins do not contribute to ΔI_{CC}.
- 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.

Figure 3. VOLTAGE TRANSLATION

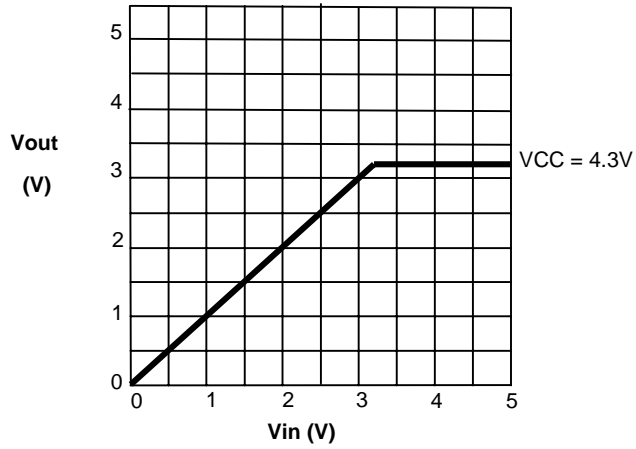


Figure 4. VOH CHARACTERISTICS

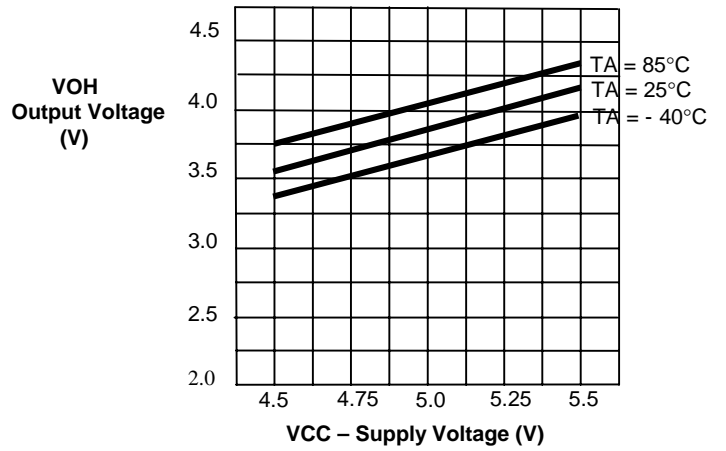


Figure 5. Voltage Translation Application

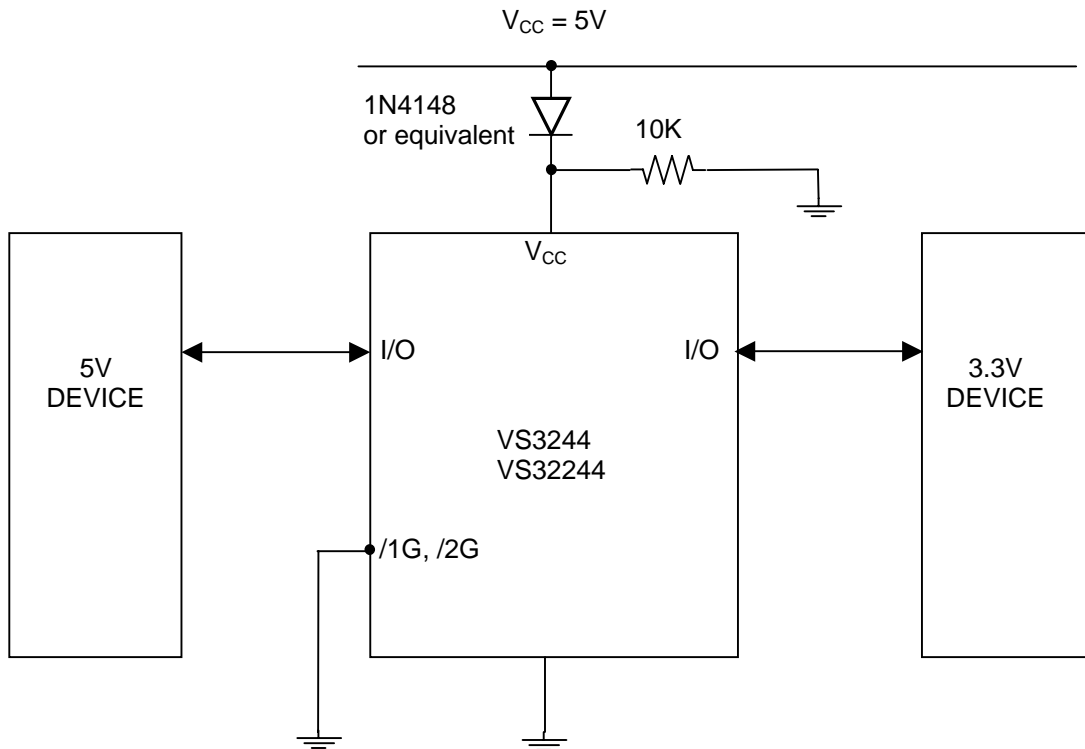


Table 8. Switching Characteristics Over Operating Range

$T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 5.0\text{V} \pm 10\%$
 $C_{LOAD} = 50\text{pF}$, $R_{LOAD} = 500\Omega$ unless otherwise stated.

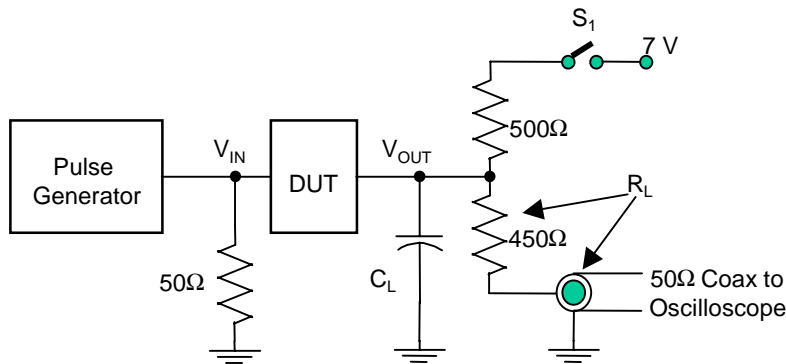
Symbol	Description ⁽¹⁾	VS3245		VS32245		Units
		Min ⁽³⁾	Max	Min ⁽³⁾	Max	
t_{PLH} , t_{PHL}	Data Propagation Delay ^(2,3) through the switch		0.25		1.25	ns
t_{PZH} , t_{PZL}	Switch Turn-on Delay, /1G, /2G to A or B	0.5	5.6	0.5	6.6	ns
t_{PLZ} , t_{PHZ}	Switch Turn-off Delay /1G, /2G to A or B	0.5	4.5	0.5	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 VS3244 and 1.25 ns for VS32244. 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 5. AC Test Circuit and Switching Waveforms

AC Test Circuit



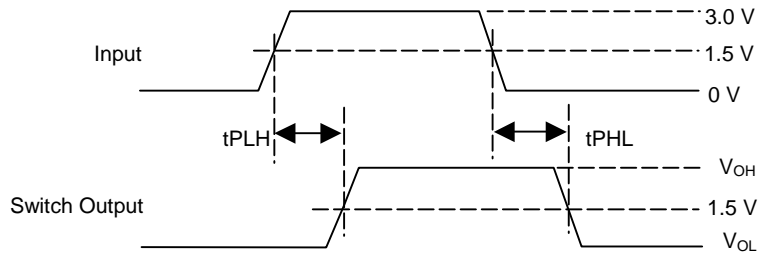
Load Switch Position

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

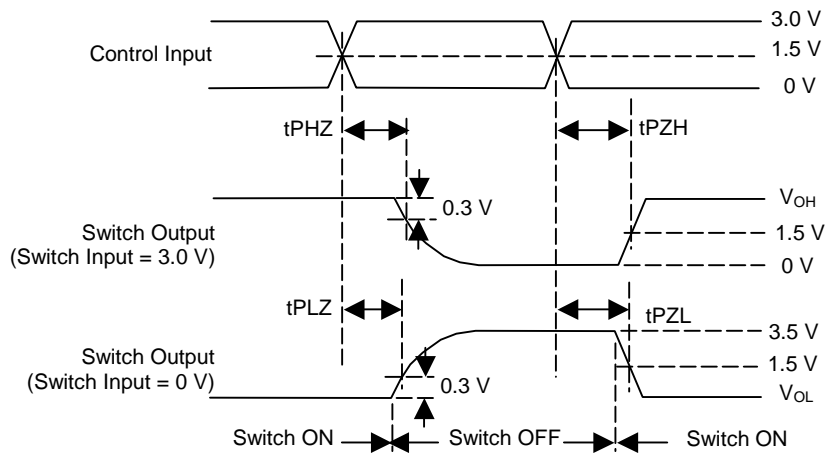
Input Conditions

Input voltage = 0 V to 3.0 V
 $t_r = t_f = 2.5\text{ns}$ (10% to 90%)

Switching Waveforms



Propagation Delay



Enable and Disable Times

Ordering Information

Part Number	Marking	Shipping/Packaging	No. of Pins	Package	Temperature
VS3244Q	VS3244Q	Tubes	20	QSOP	-40°C to +85°C
VS3244QX	VS3244Q	Tape & Reel	20	QSOP	-40°C to +85°C
VS32244Q	VS32244Q	Tubes	20	QSOP	-40°C to +85°C
VS32244QX	VS32244Q	Tape & Reel	20	QSOP	-40°C to +85°C