VS3V253 / VS3V2253
High-speed 3.3V CMOS VSwitch
Dual 4:1 Mux/Demux

Vaishali Semiconductor

Applications

- 3.3V to 2.5V translation
- 2.5V to 1.8V translation
- Hot-Swapping

- Logic replacement
- Memory bank, video, and audio switching

General Description

The VS3V253 is a high-speed LVTTL–compatible dual 4:1 multiplexer/demultiplexer. The VS3V2253 contains two mux/demux channels with common path control (S0 & S1) and individual active LOW enables $/E_A$ and $/E_B$. The low ON resistance of VS3V253 allows inputs to be connected to outputs without adding propagation delay and without generating additional signal noise. The VS3V2253 has 25Ω resistors in series with the switches to reduce ground-bounce noise and signal reflections.

The VS3V253 and VS3V2253 mux/demux switches are designed for 3.3V to 2.5V, or 2.5V to 1.8V translation, underline without any external components. These switches also offer very high impedance between switch terminals in the power off or 'disabled' state. This feature, combined with near-zero propagation delay in the 'on' state, makes VS3V253 and VS3V2253 ideal interface elements for hot-swapping applications.

Features

- Enhanced N-FET with no DC path to V_{CC} or GND in normal operating signal voltage range.
- Low impedance switches connect inputs to outputs with near-zero propagation delay: 5Ω (VS3V253) and 25Ω (VS3V2253)
- Pin-compatible with 74LVC253 or equivalent logic devices
- Zero added ground bounce or signal noise

- Break-before-make feature
- 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 QSOP package



Figure 1. Functional Block Diagram
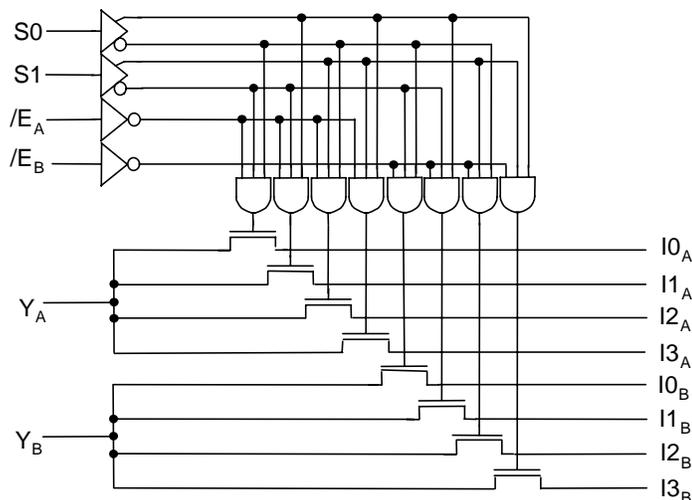
Figure 2. Pin Configuration

QSOP

$/E_A$	1	16 V_{CC}
S1	2	15 $/E_B$
$I3_A$	3	14 S0
$I2_A$	4	13 $I3_B$
$I1_A$	5	12 $I2_B$
$I0_A$	6	11 $I1_B$
Y_A	7	10 $I0_B$
GND	8	9 Y_B
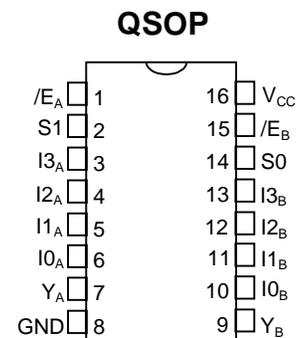
(All Pins Top View)

Table 1. Pin Description

Name	I/O	Description
IX_A, IX_B	I/O	Data Input or Output
S0, S1	I	Select Input
$/E_A$, $/E_B$	I	Enable Input
Y_A - Y_B	I/O	Data Output or Input

Table 2. Function Table

Inputs		Select		Outputs		Function
$/E_A$	$/E_B$	S1	S0	Y_A	Y_B	
H	X	X	X	Hi-Z	X	Disable A
X	H	X	X	X	Hi-Z	Disable B
L	L	L	L	$I0_A$	I0B	S1-0 = 0
L	L	L	H	I1A	I1B	S1-0 = 1
L	L	H	L	I2A	I2B	S1-0 = 2
L	L	H	H	I3A	I3B	S1-0 = 3

Table 3. Absolute Maximum Ratings

Supply Voltage to Ground………………………….….-0.5V to +4.6V
DC Switch Voltage V_S…………………………………….-0.5V to +4.6V
DC Input Voltage V_{IN}…………………………………...-0.5V to +4.6V
AC Input Voltage (Pulse Width < 20ns)………………….…………-3.0V
DC Output Sink Current per Switch Pin………………....…..128 mA
Maximum Power Dissipation……………………………….0.5 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

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

Pins	Operation	QSOP		Unit
		Typ	Max	
Control Inputs		4	5	pF
VSwitch Channels	Demux	5	7	pF
(Switch OFF)	Mux	7	8	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		2.3		3.6	V
V_{IL}	Low level input voltage (Control inputs)	Vcc = 2.3 to 2.7			0.7	V
		Vcc =2.7 to 3.6			0.8	
V_{IH}	High level input voltage (Control inputs)	Vcc = 2.3 to 2.7	1.7			V
		Vcc = 2.7 to 3.6	2.0			
T_A	Operating free-air temperature		-40		85	^{o}C

Note: All unused control inputs of the device must be held at Vcc or GND, to ensure proper device operation

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

Symbol	Parameter	Test Conditions			Min	Typ	Max	Units
V_{IK}	Clamp Voltage	Control Inputs	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} = 3.3V, I_{OUT} = -100μA		2.3		2.7	V
			V_{IN} = V_{CC} = 2.5V, I_{OUT} = -100μA		1.5		2.0	
I_I	Input Leakage Current	Control Inputs	V_{CC} = Max, V_I = V_{CC} or GND				1	μA
$|I_{OFF}|$	Power OFF Leakage Current	Control Inputs	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}, /E_A = /E_B = V_{CC}				1	μA
I_{ODL}	Switch I/O Drive Current (Logic LOW)	V_{CC} = 3.0V, V_{IN} = 0, V_{OUT} = 0.7V	VS3V253		50			mA
			VS3V2253		30			mA
I_{ODH}	Switch I/O Drive Current (Logic HIGH)	V_{CC} = 3.0V, V_{IN} = V_{CC}, V_{OUT} = 1.8V	VS3V253		-50			mA
			VS3V2253		-20			mA
R_{ON}	Switch ON Resistance[1]	V_{CC} = 3.0V, V_{IN} = 0, I_{OUT} = 15mA	VS3V253			5[2]	7	Ω
			VS3V2253		20	28[2]	40	Ω
		V_{CC} = 2.3V, V_{IN} = 0V, I_{OUT} = 8mA	VS3V253			10[3]	14	Ω
			VS3V2253		23	35[3]	48	Ω

Notes:
1. 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.
2. Typical value is specified at V_{CC} = 3.3V and T_A = 25°C.
3. Typical value is specified at V_{CC} = 2.5V and T_A = 25°

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} = 3.6V, S_X, /E_X = V_{CC} or GND, f = 0	1	μA
ΔI_{CC}	Power Supply Current per Input High [2] (Control Inputs)	V_{CC} = 3.6V, V_{IN} = 3.0V, f = 0	300	μA
		V_{CC} = 2.7V, V_{IN} = 2.0V, f = 0		
Q_{CCD}	Dynamic Power Supply Current [3]	V_{CC} = Max, Switch pins open, Control Inputs toggling at 50% duty cycle	0.15	mA/MHz

Notes:
1. For conditions shown as Min or Max, use the appropriate values per *Recommended Operating Conditions*.
2. Per 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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VOLTAGE TRANSLATION
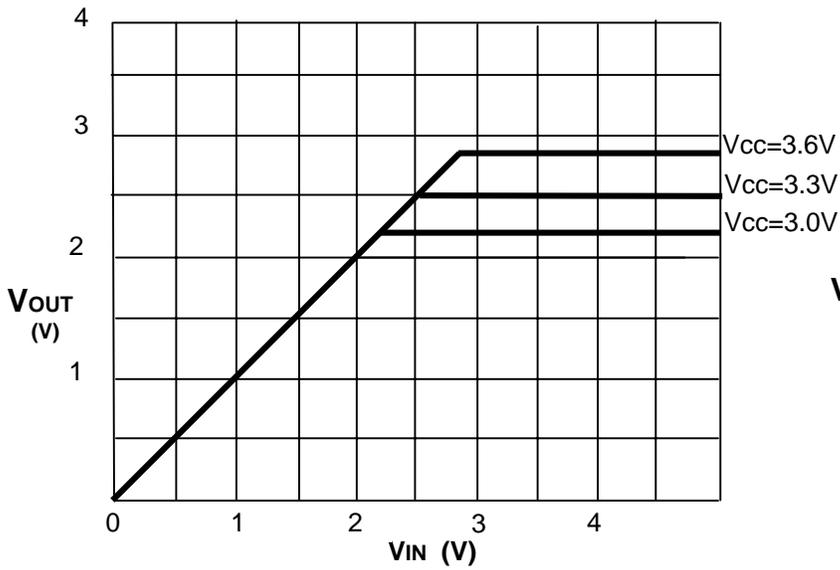
Figure 3. 3.3V to 2.5V Translation
(T_A + 25 °C)
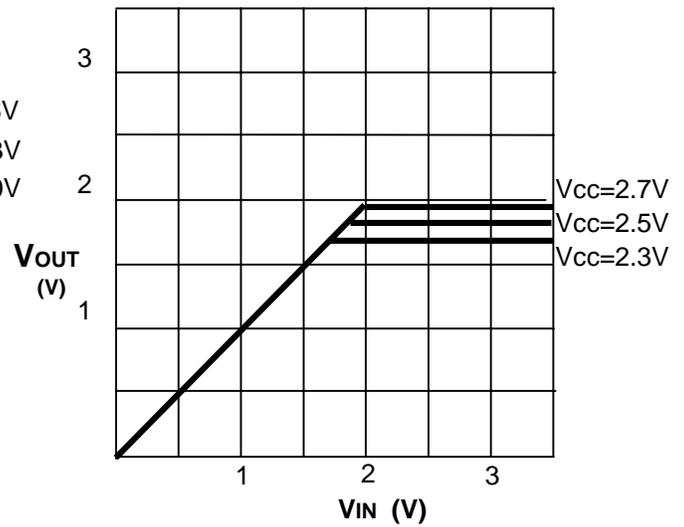
Figure 4. 2.5V to 1.8V Translation
(T_A + 25 °C)

## V_{OH} CHARACTERISTICS
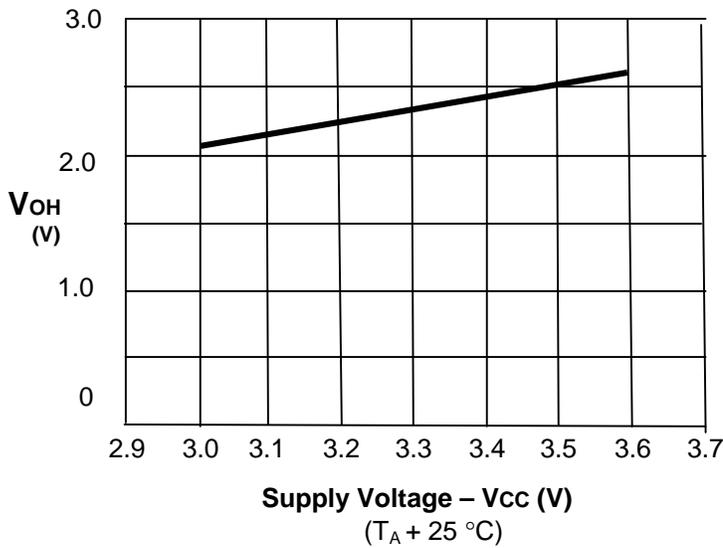
**Figure 5. V_{OH} CHARACTERISTICS
(Vcc = 3.3V nominal)**
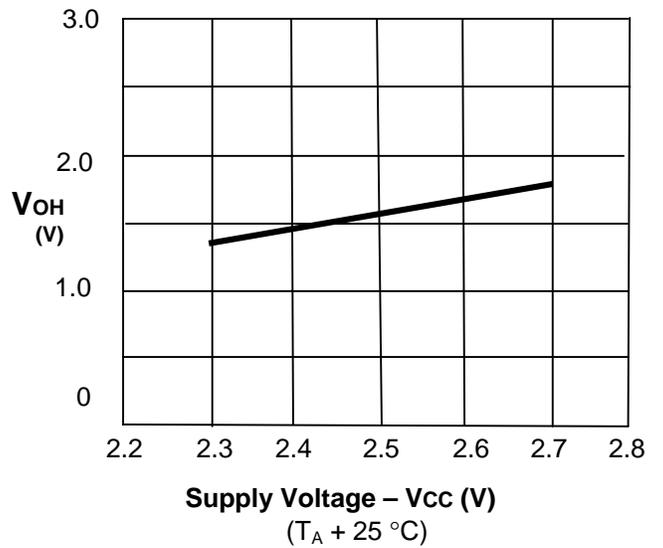
**Figure 6. V_{OH} CHARACTERISTICS
(Vcc = 2.5V nominal)**

Table 8. Switching Characteristics Over Operating Range – 3.3V Supply Voltage

T_A = -40°C to +85°C, V_{CC} = 3.3V $\pm$ 0.3V
C_{LOAD} = 30pF, R_{LOAD} = 500Ω unless otherwise stated.

Symbol	Description [1]	VS3V253 Min[3]	Max	VS3V2253 Min[3]	Max	Units
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, S0 or S1 to Y_X, I_{XX}	0.5	5.2	0.5	6.2	ns
t_{PZH}, t_{PZL}	Switch Turn-on Delay, /E_A or /E_B to Y_X, I_{XX}	0.5	4.8	0.5	5.8	ns
t_{PLZ}, t_{PHZ}	Switch Turn-off Delay [3], S_X or /E_X to Y_X, I_{XX}	0.5	5.0	0.5	5.0	ns

Table 9. Switching Characteristics Over Operating Range – 2.5V Supply Voltage

T_A = -40°C to +85°C, V_{CC} = 2.5V $\pm$ 0.2V
C_{LOAD} = 30pF, R_{LOAD} = 500Ω unless otherwise stated.

Symbol	Description [1]	VS3V253 Min[3]	Max	VS3V2253 Min[3]	Max	Units
t_{PLH}, t_{PHL}	Data Propagation Delay [2,3] through the switch					ns
t_{PZH}, t_{PZL}	Switch Turn-on Delay, S to Y_X, $I0_X$, or I_X					ns
t_{PZH}, t_{PZL}	Switch Turn-on Delay, /E to Y_X, $I0_X$, or I_X					ns
t_{PLZ}, t_{PHZ}	Switch Turn-off Delay [3], S or /E to Y_X, $I0_X$, or I_X					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 VS3V253 and 1.25 ns for VS3V2253. 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 7. AC Test Circuit and Switching Waveforms

AC Test Circuit—3.3V Supply Voltage
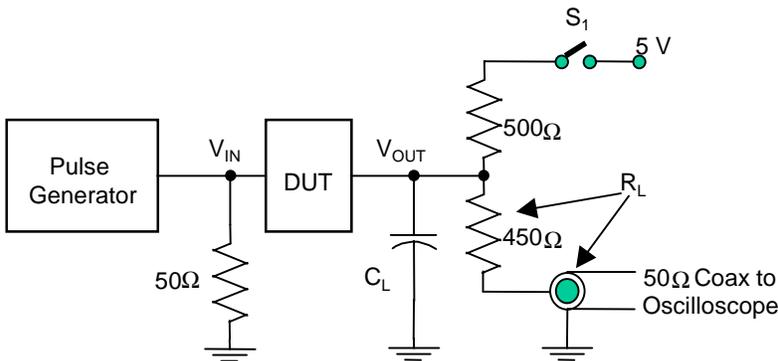
Load Switch Position

| 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
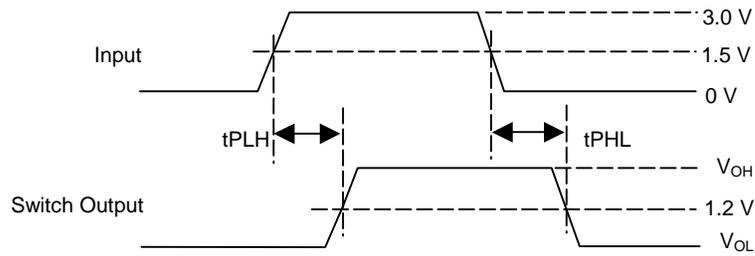
Propagation Delay
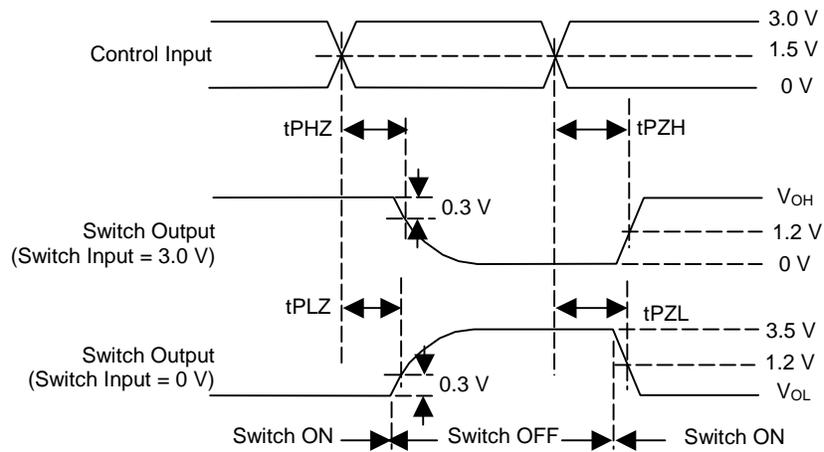
Enable and Disable Times

Ordering Information

Part Number	Marking	Shipping/Packaging	No. of Pins	Package	Temperature
VS3V253Q	VS3V253Q	Tubes	16	QSOP	-40°C to +85°C
VS3V253QX	VS3V253Q	Tape & Reel	16	QSOP	-40°C to +85°C
VS3V2253Q	VS3V2253Q	Tubes	16	QSOP	-40°C to +85°C
VS3V2253QX	VS3V2253Q	Tape & Reel	16	QSOP	-40°C to +85°C