



August 2001
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74VCX32245

Low Voltage 32-Bit Bidirectional Transceiver with 3.6V Tolerant Inputs and Outputs (Preliminary)

General Description

The VCX32245 contains thirty-two non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The device is byte controlled. Each byte has separate 3-STATE control inputs which can be shorted together for full 32-bit operation. The $T/\bar{R}$ inputs determine the direction of data flow through the device. The $\overline{OE}$ inputs disable both the A and B ports by placing them in a high impedance state.

The 74VCX32245 is designed for low voltage (1.65V to 3.6V) V_{CC} applications with I/O compatibility up to 3.6V.

The 74VCX32245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

Features

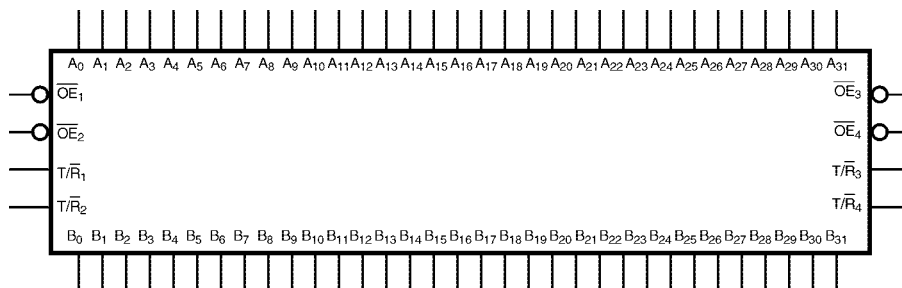
- 1.65V–3.6V V_{CC} supply operation
 - 3.6V tolerant inputs and outputs
 - t_{PD}
 - 2.5 ns max for 3.0V to 3.6V V_{CC}
 - 3.0 ns max for 2.3V to 2.7V V_{CC}
 - 6.0 ns max for 1.65V to 1.95V V_{CC}
 - Power-down high impedance inputs and outputs
 - Supports live insertion/withdrawal (Note 1)
 - Static Drive (I_{OH}/I_{OL})
 - ± 24 mA @ 3.0V V_{CC}
 - ± 18 mA @ 2.3V V_{CC}
 - ± 6 mA @ 1.65V V_{CC}
 - Uses patented noise/EMI reduction circuitry
 - Latchup performance exceeds 300 mA
 - ESD performance:
 - Human body model > 2000V
 - Machine model > 200V
 - Packaged in plastic Fine-Pitch Ball Grid Array (FBGA)
- Note 1:** To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

Ordering Code:

Order Number	Package Number	Package Description
74VCX32245GX (Note 2)	BGA96A	96-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide [Tape and Reel]

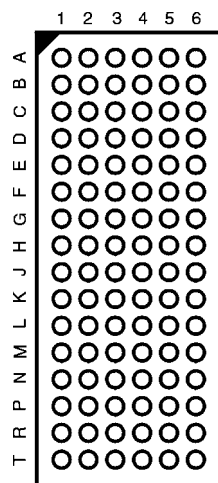
Note 2: BGA package available in Tape and Reel only.

Logic Symbol



74VCX32245 Low Voltage 32-Bit Bidirectional Transceiver with 3.6V Tolerant Inputs and Outputs (Preliminary)

Connection Diagram



(Top Thru View)

Truth Tables

Inputs		Outputs
$\overline{OE}_1$	$T/\overline{R}_1$	
L	L	Bus B ₀ –B ₇ Data to Bus A ₀ –A ₇
L	H	Bus A ₀ –A ₇ Data to Bus B ₀ –B ₇
H	X	HIGH Z State on A ₀ –A ₇ , B ₀ –B ₇

Inputs		Outputs
$\overline{OE}_2$	$T/\overline{R}_2$	
L	L	Bus B ₈ –B ₁₅ Data to Bus A ₈ –A ₁₅
L	H	Bus A ₈ –A ₁₅ Data to Bus B ₈ –B ₁₅
H	X	HIGH Z State on A ₈ –A ₁₅ , B ₈ –B ₁₅

Inputs		Outputs
$\overline{OE}_3$	$T/\overline{R}_3$	
L	L	Bus B ₁₆ –B ₂₃ Data to Bus A ₁₆ –A ₂₃
L	H	Bus A ₁₆ –A ₂₃ Data to Bus B ₁₆ –B ₂₃
H	X	HIGH Z State on A ₁₆ –A ₂₃ , B ₁₆ –B ₂₃

Inputs		Outputs
$\overline{OE}_4$	$T/\overline{R}_4$	
L	L	Bus B ₂₄ –B ₃₁ Data to Bus A ₂₄ –A ₃₁
L	H	Bus A ₂₄ –A ₃₁ Data to Bus B ₂₄ –B ₃₁
H	X	HIGH Z State on A ₂₄ –A ₃₁ , B ₂₄ –B ₃₁

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial (HIGH or LOW, inputs and I/O's may not float)

Z = High Impedance

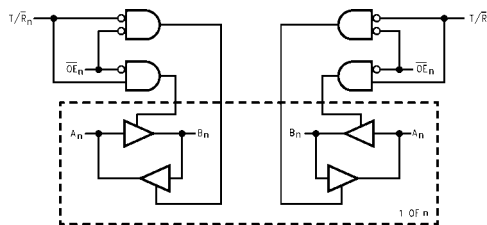
Pin Descriptions

Pin Names	Description
$\overline{OE}_n$	Output Enable Input (Active LOW)
$T/\overline{R}_n$	Transmit/Receive Input
A ₀ –A ₃₁	Side A Inputs or 3-STATE Outputs
B ₀ –B ₃₁	Side B Inputs or 3-STATE Outputs

FBGA Pin Assignments

	1	2	3	4	5	6
A	B ₁	B ₀	$T/\overline{R}_1$	$\overline{OE}_1$	A ₀	A ₁
B	B ₃	B ₂	GND	GND	A ₂	A ₃
C	B ₅	B ₄	V _{CC}	V _{CC}	A ₄	A ₅
D	B ₇	B ₆	GND	GND	A ₆	A ₇
E	B ₉	B ₈	GND	GND	A ₈	A ₉
F	B ₁₁	B ₁₀	V _{CC}	V _{CC}	A ₁₀	A ₁₁
G	B ₁₃	B ₁₂	GND	GND	A ₁₂	A ₁₃
H	B ₁₄	B ₁₅	$T/\overline{R}_2$	$\overline{OE}_2$	A ₁₅	A ₁₄
J	B ₁₇	B ₁₆	$T/\overline{R}_3$	$\overline{OE}_3$	A ₁₆	A ₁₇
K	B ₁₉	B ₁₈	GND	GND	A ₁₈	A ₁₉
L	B ₂₁	B ₂₀	V _{CC}	V _{CC}	A ₂₀	A ₂₁
M	B ₂₃	B ₂₂	GND	GND	A ₂₂	A ₂₃
N	B ₂₅	B ₂₄	GND	GND	A ₂₄	A ₂₅
P	B ₂₇	B ₂₆	V _{CC}	V _{CC}	A ₂₆	A ₂₇
R	B ₂₉	B ₂₈	GND	GND	A ₂₈	A ₂₉
T	B ₃₀	B ₃₁	$T/\overline{R}_4$	$\overline{OE}_4$	A ₃₁	A ₃₀

Logic Diagram



Absolute Maximum Ratings(Note 3)

Supply Voltage (V_{CC})	–0.5V to +4.6V
DC Input Voltage (V_I)	–0.5V to +4.6V
Output Voltage (V_O)	
Outputs 3-STATE	–0.5V to +4.6V
Outputs Active (Note 4)	–0.5 to $V_{CC} + 0.5V$
DC Input Diode Current (I_{IK}) $V_I < 0V$	–50 mA
DC Output Diode Current (I_{OK})	
$V_O < 0V$	–50 mA
$V_O > V_{CC}$	+50 mA
DC Output Source/Sink Current (I_{OH}/I_{OL})	±50 mA
DC V_{CC} or Ground Current per Supply Pin (I_{CC} or Ground)	±100 mA
Storage Temperature Range (T_{STG})	–65°C to +150°C

Recommended Operating Conditions (Note 5)

Power Supply	
Operating	1.65V to 3.6V
Data Retention Only	1.2V to 3.6V
Input Voltage	–0.3V to 3.6V
Output Voltage (V_O)	
Output in Active States	0V to V_{CC}
Output in 3-STATE	0.0V to 3.6V
Output Current in I_{OH}/I_{OL}	
$V_{CC} = 3.0V$ to 3.6V	±24 mA
$V_{CC} = 2.3V$ to 2.7V	±18 mA
$V_{CC} = 1.65V$ to 2.3V	±6 mA
Free Air Operating Temperature (T_A)	–40°C to +85°C
Minimum Input Edge Rate ($\Delta t/\Delta V$)	
$V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$	10 ns/V

Note 3: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the Absolute Maximum Ratings. The Recommended Operating Conditions tables will define the conditions for actual device operation.

Note 4: I_O Absolute Maximum Rating must be observed.

Note 5: Floating or unused pin (inputs or I/O's) must be held HIGH or LOW.

DC Electrical Characteristics (2.7V < V_{CC} ≤ 3.6V)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.7–3.6	2.0		V
V_{IL}	LOW Level Input Voltage		2.7–3.6		0.8	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$ $I_{OH} = -12 \text{ mA}$ $I_{OH} = -18 \text{ mA}$ $I_{OH} = -24 \text{ mA}$	2.7–3.6 2.7 3.0 3.0	$V_{CC} - 0.2$ 2.2 2.4 2.2		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$ $I_{OL} = 12 \text{ mA}$ $I_{OL} = 18 \text{ mA}$ $I_{OL} = 24 \text{ mA}$	2.7–3.6 2.7 3.0 3.0		0.2 0.4 0.4 0.55	V
I_I	Input Leakage Current	$0V \leq V_I \leq 3.6V$	2.7–3.6		±5.0	μA
I_{OZ}	3-STATE Output Leakage	$0V \leq V_O \leq 3.6V$ $V_I = V_{IH}$ or V_{IL}	2.7–3.6		±10	μA
I_{OFF}	Power Off Leakage Current	$0V \leq (V_I, V_O) \leq 3.6V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND $V_{CC} \leq (V_I, V_O) \leq 3.6V$ (Note 6)	2.7–3.6 2.7–3.6		40 ±40	μA
ΔI_{CC}	Increase in I_{CC} per Input	$V_{IH} = V_{CC} - 0.6V$	2.7–3.6		750	μA

Note 6: Outputs disabled or 3-STATE only.

DC Electrical Characteristics ($2.3V \leq V_{CC} \leq 2.7V$)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.3–2.7	1.6		V
V_{IL}	LOW Level Input Voltage		2.3–2.7		0.7	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$ $I_{OH} = -6 \text{ mA}$ $I_{OH} = -12 \text{ mA}$ $I_{OH} = -18 \text{ mA}$	2.3–2.7 2.3 2.3 2.3	$V_{CC} - 0.2$ 2.0 1.8 1.7		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$ $I_{OL} = 12 \text{ mA}$ $I_{OL} = 18 \text{ mA}$	2.3–2.7 2.3 2.3		0.2 0.4 0.6	V
I_I	Input Leakage Current	$0 \leq V_I \leq 3.6V$	2.3–2.7		± 5.0	μA
I_{OZ}	3-STATE Output Leakage	$0 \leq V_O \leq 3.6V$ $V_I = V_{IH}$ or V_{IL}	2.3–2.7		± 10	μA
I_{OFF}	Power Off Leakage Current	$0 \leq (V_I, V_O) \leq 3.6V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND $V_{CC} \leq (V_I, V_O) \leq 3.6V$ (Note 7)	2.3–2.7 2.3–2.7		40 ± 40	μA

Note 7: Outputs disabled or 3-STATE only.

DC Electrical Characteristics ($1.65V \leq V_{CC} < 2.3V$)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		1.65-2.3	$0.65 \times V_{CC}$		V
V_{IL}	LOW Level Input Voltage		1.65-2.3		$0.35 \times V_{CC}$	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$ $I_{OH} = -6 \text{ mA}$	1.65-2.3 1.65	$V_{CC} - 0.2$ 1.25		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$ $I_{OL} = 6 \text{ mA}$	1.65-2.3 1.65		0.2 0.3	V
I_I	Input Leakage Current	$0 \leq V_I \leq 3.6V$	1.65-2.3		± 5.0	μA
I_{OZ}	3-STATE Output Leakage	$0 \leq V_O \leq 3.6V$ $V_I = V_{IH}$ or V_{IL}	1.65-2.3		± 10	μA
I_{OFF}	Power Off Leakage Current	$0 \leq (V_I, V_O) \leq 3.6V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND $V_{CC} \leq (V_I, V_O) \leq 3.6V$ (Note 8)	1.65-2.3 1.65-2.3		40 ± 40	μA

Note 8: Outputs disabled or 3-STATE only.

AC Electrical Characteristics

(Note 9)

Symbol	Parameter	T _A = -40°C to +85°C, C _L = 30 pF, R _L = 500Ω						Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.5 ± 0.2V		V _{CC} = 1.8V ± 0.15V		
		Min	Max	Min	Max	Min	Max	
t _{PHL} , t _{PLH}	Prop Delay	0.8	2.5	1.0	3.0	1.5	6.0	ns
t _{PZL} , t _{PZH}	Output Enable Time	0.8	3.8	1.0	4.9	1.5	9.3	ns
t _{PLZ} , t _{PHZ}	Output Disable Time	0.8	3.7	1.0	4.2	1.5	7.6	ns

Note 9: For C_L = 50pF, add approximately 300ps to the AC maximum specification.

Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V _{CC} (V)	T _A = +25°C	Units
				Typical	
V _{OLP}	Quiet Output Dynamic Peak V _{OL}	C _L = 30 pF, V _{IH} = V _{CC} , V _{IL} = 0V	1.8	0.25	V
			2.5	0.6	
			3.3	0.8	
V _{OLV}	Quiet Output Dynamic Valley V _{OL}	C _L = 30 pF, V _{IH} = V _{CC} , V _{IL} = 0V	1.8	-0.25	V
			2.5	-0.6	
			3.3	-0.8	
V _{OHV}	Quiet Output Dynamic Valley V _{OH}	C _L = 30 pF, V _{IH} = V _{CC} , V _{IL} = 0V	1.8	1.5	V
			2.5	1.9	
			3.3	2.2	

Capacitance

Symbol	Parameter	Conditions	T _A = +25°C	Units
C _{IN}	Input Capacitance	V _{CC} = 1.8V, 2.5V, or 3.3V, V _I = 0V or V _{CC}	6	pF
C _{IO}	Output Capacitance	V _I = 0V, or V _{CC} , V _{CC} = 1.8V, 2.5V or 3.3V	7	pF
C _{PD}	Power Dissipation Capacitance	V _I = 0V or V _{CC} , F = 10 MHz V _{CC} = 1.8V, 2.5V or 3.3V	20	pF

AC Loading and Waveforms

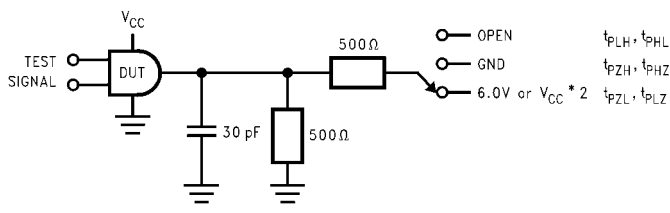


FIGURE 1. AC Test Circuit

TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$; $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$; $1.8V \pm 0.15V$
t_{PZH}, t_{PHZ}	GND

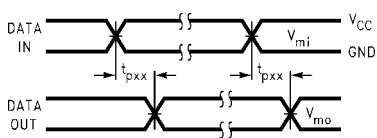


FIGURE 2. Waveform for Inverting and Non-inverting Functions

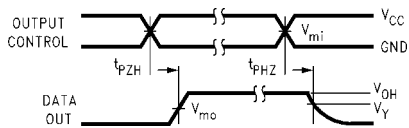


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

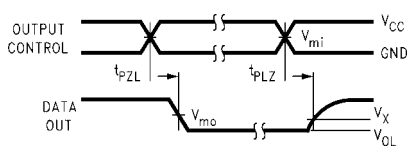


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	V_{CC}		
	$3.3V \pm 0.3V$	$2.5V \pm 0.2V$	$1.8V \pm 0.15V$
V_{mi}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_{mo}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$	$V_{OL} + 0.15V$
V_Y	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$	$V_{OH} - 0.15V$

