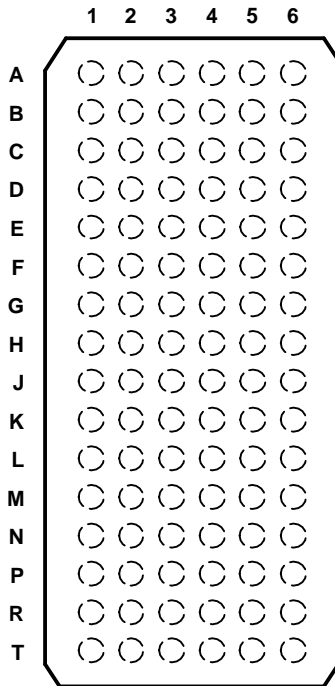


FEATURES

- Member of the Texas Instruments Widebus+™ Family
- Operates From 2.7 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max t_{pd} of 4 ns at 3.3 V
- I_{off} and Power-Up 3-State Support Hot Insertion
- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V V_{CC})
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 1000-V Charged-Device Model (C101)

GKE PACKAGE
(TOP VIEW)



TERMINAL ASSIGNMENTS

	1	2	3	4	5	6
A	1Y2	1Y1	1 \overline{OE}	2 \overline{OE}	1A1	1A2
B	1Y4	1Y3	GND	GND	1A3	1A4
C	2Y2	2Y1	V_{CC}	V_{CC}	2A1	2A2
D	2Y4	2Y3	GND	GND	2A3	2A4
E	3Y2	3Y1	GND	GND	3A1	3A2
F	3Y4	3Y3	V_{CC}	V_{CC}	3A3	3A4
G	4Y2	4Y1	GND	GND	4A1	4A2
H	4Y3	4Y4	4 \overline{OE}	3 \overline{OE}	4A4	4A3
J	5Y2	5Y1	5 \overline{OE}	6 \overline{OE}	5A1	5A2
K	5Y4	5Y3	GND	GND	5A3	5A4
L	6Y2	6Y1	V_{CC}	V_{CC}	6A1	6A2
M	6Y4	6Y3	GND	GND	6A3	6A4
N	7Y2	7Y1	GND	GND	7A1	7A2
P	7Y4	7Y3	V_{CC}	V_{CC}	7A3	7A4
R	8Y2	8Y1	GND	GND	8A1	8A2
T	8Y3	8Y4	8 \overline{OE}	7 \overline{OE}	8A4	8A3

DESCRIPTION/ORDERING INFORMATION

This 32-bit buffer/driver is designed for 2.7-V to 3.6-V V_{CC} operation.

The SN74LVCZ32244A is designed specifically to improve the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters.

The device can be used as eight 4-bit buffers, four 8-bit buffers, two 16-bit buffers, or one 32-bit buffer. It provides true outputs.

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	LFBGA – GKE	Tape and reel	SN74LVCZ32244AGKER	ZC244A

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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SN74LVCZ32244A
32-BIT BUFFER/DRIVER
WITH 3-STATE OUTPUTS

SCES422–JANUARY 2003–REVISED JUNE 2005

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of these devices as translators in a mixed 3.3-V/5-V system environment.

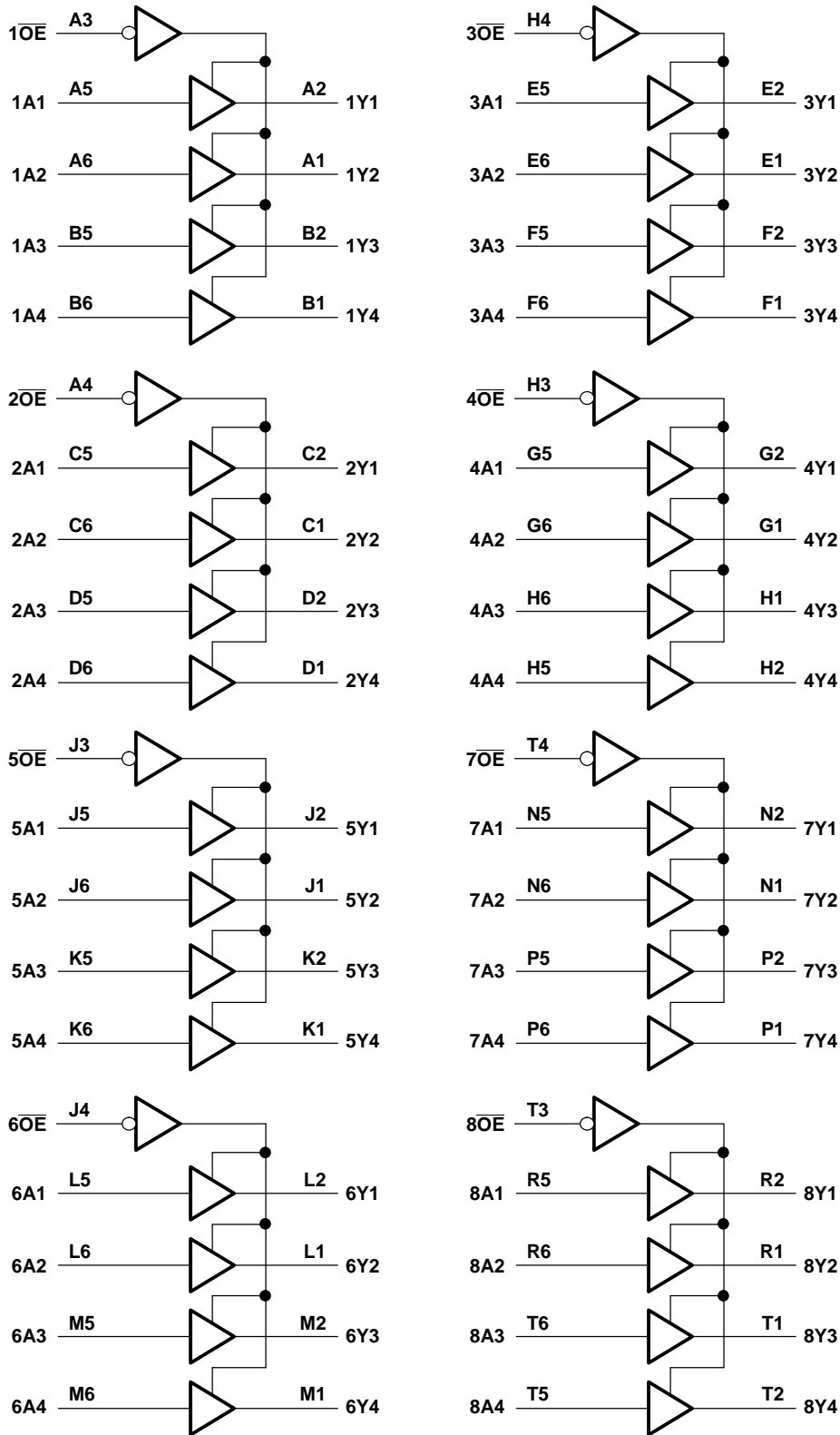
During power up or power down, when V_{CC} is between 0 and 1.5 V, the device is in the high-impedance state. However, to ensure the high-impedance state above 1.5 V, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

This device is fully specified for hot-insertion applications using I_{off} and power-up 3-state. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down ($V_{CC} = 0$ V). The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

FUNCTION TABLE
(EACH 4-BIT BUFFER)

INPUTS		OUTPUT Y
\overline{OE}	A	
L	H	H
L	L	L
H	X	Z

LOGIC DIAGRAM (POSITIVE LOGIC)



SN74LVCZ32244A

32-BIT BUFFER/DRIVER

WITH 3-STATE OUTPUTS

SCES422–JANUARY 2003–REVISED JUNE 2005

Absolute Maximum Ratings⁽¹⁾

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage range	–0.5	6.5	V
V _I	Input voltage range ⁽²⁾	–0.5	6.5	V
V _O	Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾	–0.5	6.5	V
V _O	Voltage range applied to any output in the high or low state ⁽²⁾⁽³⁾	–0.5	V _{CC} + 0.5	V
I _{IK}	Input clamp current	V _I < 0	–50	mA
I _{OK}	Output clamp current	V _O < 0	–50	mA
I _O	Continuous output current		±50	mA
	Continuous current through each V _{CC} or GND		±100	mA
θ _{JA}	Package thermal impedance ⁽⁴⁾		40	°C/W
T _{stg}	Storage temperature range	–65	150	°C

- (1) 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) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value of V_{CC} is provided in the recommended operating conditions table.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾

		MIN	MAX	UNIT
V _{CC}	Supply voltage	2.7	3.6	V
V _{IH}	High-level input voltage	V _{CC} = 2.7 V to 3.6 V		V
V _{IL}	Low-level input voltage	V _{CC} = 2.7 V to 3.6 V		V
V _I	Input voltage	0	5.5	V
V _O	Output voltage	High or low state	0	V _{CC}
		3-state	0	5.5
I _{OH}	High-level output current	V _{CC} = 2.7 V	–12	mA
		V _{CC} = 3 V	–24	
I _{OL}	Low-level output current	V _{CC} = 2.7 V	12	mA
		V _{CC} = 3 V	24	
Δt/Δv	Input transition rise or fall rate		10	ns/V
Δt/ΔV _{CC}	Power-up ramp rate	150		μs/V
T _A	Operating free-air temperature	–40	85	°C

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V _{CC}	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{OH}	I _{OH} = -100 μA	2.7 V to 3.6 V	V _{CC} - 0.2			V
	I _{OH} = -12 mA	2.7 V	2.2			
		3 V	2.4			
	I _{OH} = -24 mA	3 V	2.2			
V _{OL}	I _{OL} = 100 μA	2.7 V to 3.6 V			0.2	V
	I _{OL} = 12 mA	2.7 V			0.4	
	I _{OL} = 24 mA	3 V			0.55	
I _I	V _I = 0 to 5.5 V	3.6 V			±5	μA
I _{off}	V _I or V _O = 5.5 V	0			±5	μA
I _{OZ}	V _O = 0 to 5.5 V	3.6 V			±5	μA
I _{OZPU}	V _O = 0.5 V to 2.5 V, \overline{OE} = don't care	0 to 1.5 V			±5	μA
I _{OZPD}	V _O = 0.5 V to 2.5 V, \overline{OE} = don't care	1.5 V to 0			±5	μA
I _{CC}	V _I = V _{CC} or GND	3.6 V			200	μA
	3.6 V ≤ V _I ≤ 5.5 V ⁽²⁾				200	
ΔI _{CC}	One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND	2.7 V to 3.6 V			100	μA
C _i	V _I = V _{CC} or GND	3.3 V		4.5		pF
C _o	V _O = V _{CC} or GND	3.3 V		6		pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

(2) This applies in the disabled state only.

Switching Characteristics

over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	
t _{pd}	A	Y	1.1	4.4	1.1	4.1	ns
t _{en}	\overline{OE}	Y	1	4.9	1	4.6	ns
t _{dis}	\overline{OE}	Y	1.8	6.1	1.8	5.8	ns

Switching Characteristics

over recommended operating free-air temperature range, C_L = 30 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	
t _{pd}	A	Y	1	4.3	1	4	ns
t _{en}	\overline{OE}	Y	1	4.7	1	4.4	ns
t _{dis}	\overline{OE}	Y	1.7	5.6	1.7	5.3	ns

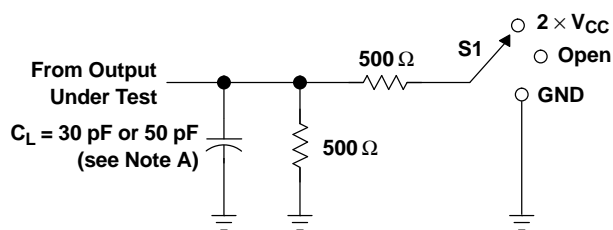
Operating Characteristics

T_A = 25°C

PARAMETER	TEST CONDITIONS	V _{CC} = 3.3 V	UNIT
		TYP	
C _{pd} Power dissipation capacitance per buffer/driver	Outputs enabled	32	pF
	Outputs disabled	5.5	

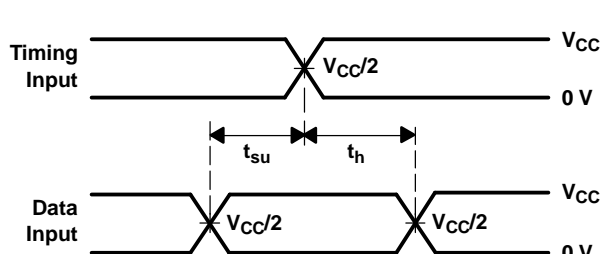
PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$

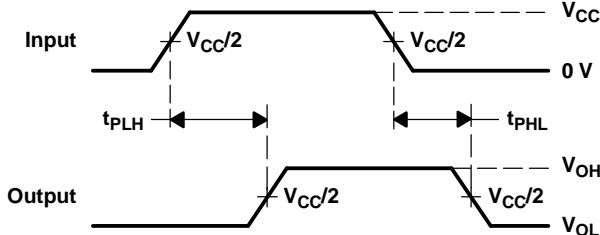


LOAD CIRCUIT

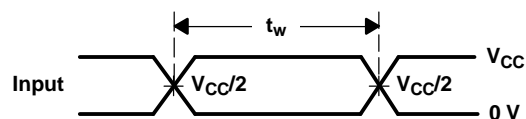
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 $\times V_{CC}$
t_{PHZ}/t_{PZH}	GND



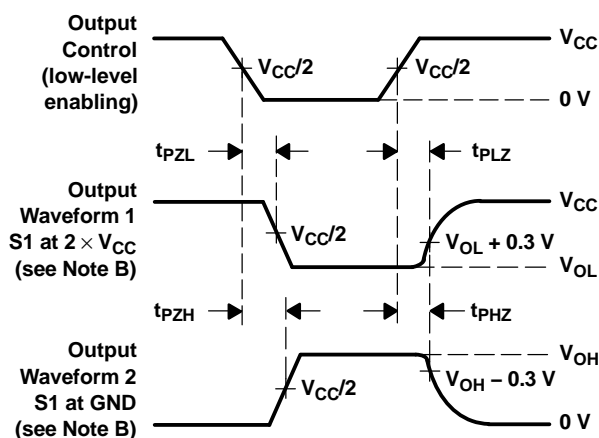
**VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS
PULSE DURATION**



**VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES**

- NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: PRR $\leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
D. The outputs are measured one at a time, with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
F. t_{PZL} and t_{PZH} are the same as t_{en} .
G. t_{PLH} and t_{PHL} are the same as t_{pd} .
H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74LVCZ32244AGKER	NRND	LFBGA	GKE	96	1000	TBD	SNPB	Level-2-235C-1 YEAR
SN74LVCZ32244AZKER	ACTIVE	LFBGA	ZKE	96	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSELETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LVCZ32244AGKER	LFBGA	GKE	96	1000	330.0	24.4	5.7	13.7	2.0	8.0	24.0	Q1
SN74LVCZ32244AZKER	LFBGA	ZKE	96	1000	330.0	24.4	5.7	13.7	2.0	8.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVCZ32244AGKER	LFBGA	GKE	96	1000	346.0	346.0	41.0
SN74LVCZ32244AZKER	LFBGA	ZKE	96	1000	346.0	346.0	41.0

GKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-205 variation CC.
 - D. This package is tin-lead (SnPb). Refer to the 96 ZKE package (drawing 4204493) for lead-free.

ZKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY



4204493/C 06/04

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-205 variation CC.
 - D. This package is lead-free. Refer to the 96 GKE package (drawing 4188953) for tin-lead (SnPb).

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