

## FEATURES

- Member of the Texas Instruments Widebus+™ Family
- DOC™ Circuitry Dynamically Changes Output Impedance, Resulting in Noise Reduction Without Speed Degradation
- Dynamic Drive Capability Is Equivalent to Standard Outputs With  $I_{OH}$  and  $I_{OL}$  of
  - $\pm 24$  mA at 3-V  $V_{CC}$
  - $\pm 15$  mA at 2.3-V  $V_{CC}$
  - $\pm 9$  mA at 1.65-V  $V_{CC}$
  - $\pm 6$  mA at 1.4-V  $V_{CC}$
- Control Inputs  $V_{IH}/V_{IL}$  Levels Are Referenced to  $V_{CCB}$  Voltage
- If Either  $V_{CC}$  Input Is at GND, Both Ports Are in the High-Impedance State
- Inputs/Outputs Can Tolerate up to 4.6 V, Which Allows Mixed-Voltage-Mode Data Communications
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.4-V to 3.6-V Power-Supply Range
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

## DESCRIPTION/ORDERING INFORMATION

This 32-bit noninverting bus transceiver uses two separate configurable power-supply rails. The A port is designed to track  $V_{CCA}$ .  $V_{CCA}$  accepts any supply voltage from 1.4 V to 3.6 V. The B port is designed to track  $V_{CCB}$ .  $V_{CCB}$  accepts any supply voltage from 1.4 V to 3.6 V. This allows for universal low-voltage bidirectional translation between any of the 1.5-V, 1.8-V, 2.5-V, and 3.3-V voltage nodes.

The SN74AVCB324245 is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the outputs so the buses are effectively isolated.

The SN74AVCB324245 is designed so that the control pins (1DIR, 2DIR,  $1\overline{OE}$ , and  $2\overline{OE}$ ) are supplied by  $V_{CCB}$ .

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  shall be tied to  $V_{CCB}$  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 partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down. If either  $V_{CC}$  input is at GND, both ports are in the high-impedance state.

## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	LFBGA – GKE	Tape and reel	SN74AVCB324245KR	WD4245
	LFBGA – ZKE (Pb-free)		74AVCB324245ZKER	

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

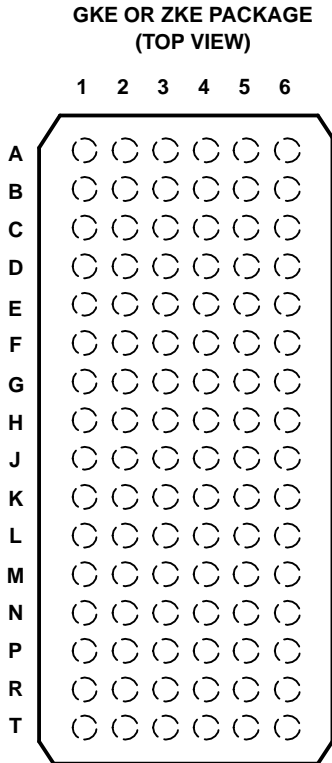


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**SN74AVCB324245**  
**32-BIT DUAL-SUPPLY BUS TRANSCEIVER**  
**WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS**

SCES485A—AUGUST 2003—REVISED MARCH 2005



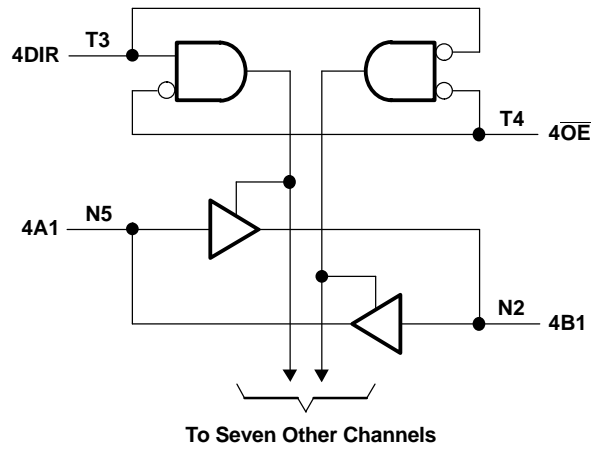
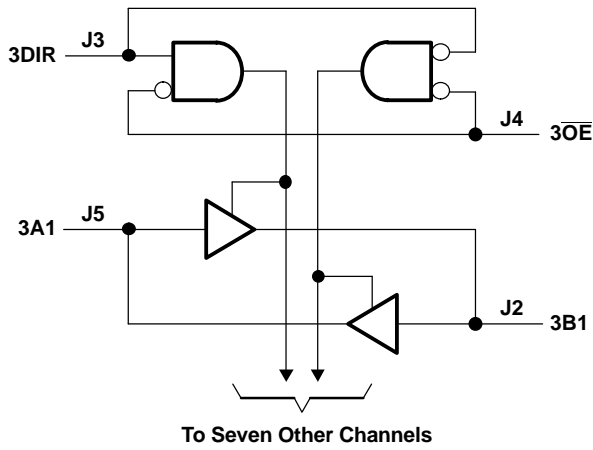
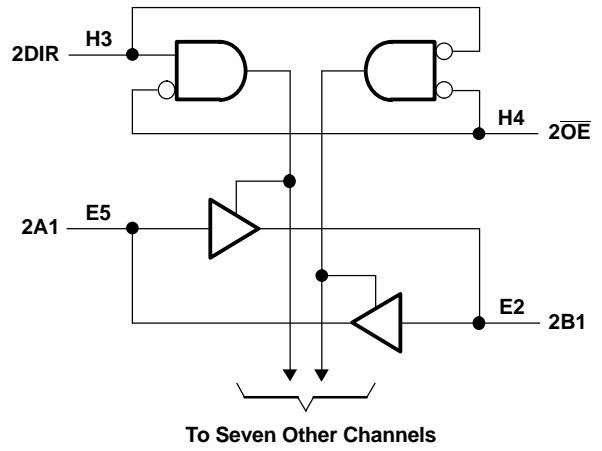
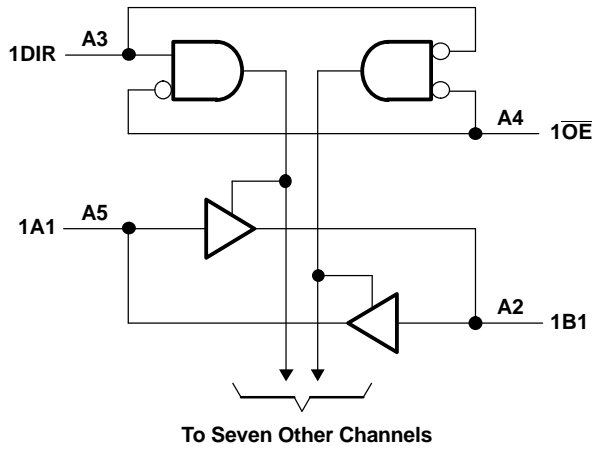
**TERMINAL ASSIGNMENTS**

	1	2	3	4	5	6
<b>A</b>	1B2	1B1	1DIR	1 $\overline{OE}$	1A1	1A2
<b>B</b>	1B4	1B3	GND	GND	1A3	1A4
<b>C</b>	1B6	1B5	V <sub>CCB</sub>	V <sub>CCA</sub>	1A5	1A6
<b>D</b>	1B8	1B7	GND	GND	1A7	1A8
<b>E</b>	2B2	2B1	GND	GND	2A1	2A2
<b>F</b>	2B4	2B3	V <sub>CCB</sub>	V <sub>CCA</sub>	2A3	2A4
<b>G</b>	2B6	2B5	GND	GND	2A5	2A6
<b>H</b>	2B7	2B8	2DIR	2 $\overline{OE}$	2A8	2A7
<b>J</b>	3B2	3B1	3DIR	3 $\overline{OE}$	3A1	3A2
<b>K</b>	3B4	3B3	GND	GND	3A3	3A4
<b>L</b>	3B6	3B5	V <sub>CCB</sub>	V <sub>CCA</sub>	3A5	3A6
<b>M</b>	3B8	3B7	GND	GND	3A7	3A8
<b>N</b>	4B2	4B1	GND	GND	4A1	4A2
<b>P</b>	4B4	4B3	V <sub>CCB</sub>	V <sub>CCA</sub>	4A3	4A4
<b>R</b>	4B6	4B5	GND	GND	4A5	4A6
<b>T</b>	4B7	4B8	4DIR	4 $\overline{OE}$	4A8	4A7

**FUNCTION TABLE (EACH 8-BIT SECTION)**

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

**LOGIC DIAGRAM (POSITIVE LOGIC)**



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**Absolute Maximum Ratings**<sup>(1)</sup>

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

		MIN	MAX	UNIT	
$V_{CCA}, V_{CCB}$	Supply voltage range	–0.5	4.6	V	
$V_I$	Input voltage range <sup>(2)</sup>	I/O ports (A port)	–0.5	4.6	V
		I/O ports (B port)	–0.5	4.6	
		Control inputs	–0.5	4.6	
$V_O$	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup>	A port	–0.5	4.6	V
		B port	–0.5	4.6	
$V_O$	Voltage range applied to any output in the high or low state <sup>(2)(3)</sup>	A port	–0.5	$V_{CCA} + 0.5$	V
		B port	–0.5	$V_{CCB} + 0.5$	
$I_{IK}$	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 $V_{CCA}, V_{CCB},$ or GND			±100
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>	GKE/ZKE package		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 voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

**Recommended Operating Conditions**<sup>(1)(2)(3)</sup>

			V <sub>CCI</sub>	V <sub>CCO</sub>	MIN	MAX	UNIT
V <sub>CCA</sub>	Supply voltage				1.4	3.6	V
V <sub>CCB</sub>	Supply voltage				1.4	3.6	V
V <sub>IH</sub>	High-level input voltage	Data inputs	1.4 V to 1.95 V		V <sub>CCI</sub> × 0.65	3.6	V
			1.95 V to 2.7 V		1.7	3.6	
			2.7 V to 3.6 V		2	3.6	
V <sub>IL</sub>	Low-level input voltage	Data inputs	1.4 V to 1.95 V		0	V <sub>CCI</sub> × 0.35	V
			1.95 V to 2.7 V		0	0.7	
			2.7 V to 3.6 V		0	0.8	
V <sub>IH</sub>	High-level input voltage	Control inputs (referenced to V <sub>CCB</sub> )	1.4 V to 1.95 V		V <sub>CCB</sub> × 0.65	V <sub>CCB</sub>	V
			1.95 V to 2.7 V		1.7	V <sub>CCB</sub>	
			2.7 V to 3.6 V		2	V <sub>CCB</sub>	
V <sub>IL</sub>	Low-level input voltage	Control inputs (referenced to V <sub>CCB</sub> )	1.4 V to 1.95 V		0	V <sub>CCB</sub> × 0.35	V
			1.95 V to 2.7 V		0	0.7	
			2.7 V to 3.6 V		0	0.8	
V <sub>O</sub>	Output voltage				0	V <sub>CCO</sub>	V
I <sub>OH</sub>	High-level output current		1.4 V to 1.6 V			–2	mA
			1.65 V to 1.95 V			–4	
			2.3 V to 2.7 V			–8	
			3 V to 3.6 V			–12	
I <sub>OL</sub>	Low-level output current		1.4 V to 1.6 V			2	mA
			1.65 V to 1.95 V			4	
			2.3 V to 2.7 V			8	
			3 V to 3.6 V			12	
Δt/Δv	Input transition rise or fall rate					5	ns/V
T <sub>A</sub>	Operating free-air temperature				–40	85	°C

(1) V<sub>CCI</sub> is the V<sub>CC</sub> associated with the data input port.

(2) V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

(3) All unused data inputs of the device must be held at V<sub>CCI</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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**Electrical Characteristics**<sup>(1)(2)</sup>

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

PARAMETER		TEST CONDITIONS		V <sub>CCA</sub>	V <sub>CCB</sub>	MIN	TYP <sup>(3)</sup>	MAX	UNIT
V <sub>OH</sub>		I <sub>OH</sub> = -100 μA	V <sub>I</sub> = V <sub>IH</sub>	1.4 V to 3.6 V	1.4 V to 3.6 V	V <sub>CCO</sub> - 0.2			V
		I <sub>OH</sub> = -2 mA	V <sub>I</sub> = V <sub>IH</sub>	1.4 V	1.4 V	1.05			
		I <sub>OH</sub> = -4 mA	V <sub>I</sub> = V <sub>IH</sub>	1.65 V	1.65 V	1.2			
		I <sub>OH</sub> = -8 mA	V <sub>I</sub> = V <sub>IH</sub>	2.3 V	2.3 V	1.75			
		I <sub>OH</sub> = -12 mA	V <sub>I</sub> = V <sub>IH</sub>	3 V	3 V	2.3			
V <sub>OL</sub>		I <sub>OH</sub> = 100 μA	V <sub>I</sub> = V <sub>IL</sub>	1.4 V to 3.6 V	1.4 V to 3.6 V	0.2			V
		I <sub>OH</sub> = 2 mA	V <sub>I</sub> = V <sub>IL</sub>	1.4 V	1.4 V	0.35			
		I <sub>OH</sub> = 4 mA	V <sub>I</sub> = V <sub>IL</sub>	1.65 V	1.65 V	0.45			
		I <sub>OH</sub> = 8 mA	V <sub>I</sub> = V <sub>IL</sub>	2.3 V	2.3 V	0.55			
		I <sub>OH</sub> = 12 mA	V <sub>I</sub> = V <sub>IL</sub>	3 V	3 V	0.7			
V <sub>OH</sub>		I <sub>OHD</sub> = -6 mA	V <sub>I</sub> = V <sub>IH</sub>	1.4 V	1.4 V	1.05			V
		I <sub>OHD</sub> = -9 mA	V <sub>I</sub> = V <sub>IH</sub>	1.65 V	1.65 V	1.2			
		I <sub>OHD</sub> = -15 mA	V <sub>I</sub> = V <sub>IH</sub>	2.3 V	2.3 V	1.75			
		I <sub>OHD</sub> = -24 mA	V <sub>I</sub> = V <sub>IH</sub>	3 V	3 V	2.3			
V <sub>OL</sub>		I <sub>OHD</sub> = 6 mA	V <sub>I</sub> = V <sub>IL</sub>	1.4 V	1.4 V	0.35			V
		I <sub>OHD</sub> = 9 mA	V <sub>I</sub> = V <sub>IL</sub>	1.65 V	1.65 V	0.45			
		I <sub>OHD</sub> = 15 mA	V <sub>I</sub> = V <sub>IL</sub>	2.3 V	2.3 V	0.55			
		I <sub>OHD</sub> = 24 mA	V <sub>I</sub> = V <sub>IL</sub>	3 V	3 V	0.7			
I <sub>I</sub>	Control inputs	V <sub>I</sub> = V <sub>CCB</sub> or GND		1.4 V to 3.6 V	3.6 V	±2.5			μA
I <sub>off</sub>	A port	V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6 V		0 V	0 to 3.6 V	±10			μA
	B port			0 to 3.6 V	0 V	±10			
I <sub>OZ</sub> <sup>(4)</sup>	A or B ports	V <sub>O</sub> = V <sub>CCO</sub> or GND, V <sub>I</sub> = V <sub>CCI</sub> or GND	OE = V <sub>IH</sub>	3.6 V	3.6 V	±12.5			μA
	B port		OE = don't care	0 V	3.6 V	±12.5			
	A port			3.6 V	0 V	±12.5			
I <sub>CCA</sub>	V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0			1.6 V	1.6 V	40			μA
				1.95 V	1.95 V	40			
				2.7 V	2.7 V	60			
				0 V	3.6 V	-80			
				3.6 V	0 V	80			
				3.6 V	3.6 V	80			
I <sub>CCB</sub>	V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0			1.6 V	1.6 V	40			μA
				1.95 V	1.95 V	40			
				2.7 V	2.7 V	60			
				0 V	3.6 V	80			
				3.6 V	0 V	-80			
				3.6 V	3.6 V	80			
C <sub>i</sub>	Control inputs	V <sub>I</sub> = 3.3 V or GND		3.3 V	3.3 V	4			pF
C <sub>io</sub>	A or B ports	V <sub>O</sub> = 3.3 V or GND		3.3 V	3.3 V	5			pF

- (1) V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.
- (2) V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.
- (3) All typical values are at T<sub>A</sub> = 25°C.
- (4) For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

### Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 1.5\text{ V} \pm 0.1\text{ V}$  (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$		$V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$		$V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.7	6.7	1.9	6.4	1.8	5.5	1.5	5.8	ns
	B	A	1.8	6.8	1.7	6.2	1.6	5.9	1.5	5.9	
$t_{en}$	$\overline{OE}$	A	2.1	9	2.9	9.8	3.2	10	3	9.8	ns
		B	2.5	8.4	2.4	8	2.3	7.6	2.2	7.5	
$t_{dis}$	$\overline{OE}$	A	2.1	7.1	2.3	6.4	1.7	5.1	1.6	4.8	ns
		B	2.2	6.9	1.8	6.4	1.1	5.8	1.8	5.7	

### Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$  (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$		$V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$		$V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.7	6.4	1.8	6	1.7	4.7	1.6	4.3	ns
	B	A	2	6.6	1.8	6	1.8	5.6	1.8	5.5	
$t_{en}$	$\overline{OE}$	A	1.8	7.6	2.6	7.7	2.6	7.6	2.6	7.4	ns
		B	2.5	8.2	2.5	7.5	2.4	7.4	2.3	7.2	
$t_{dis}$	$\overline{OE}$	A	1.8	7	2.5	6.3	1.8	4.7	1.7	4.4	ns
		B	2.5	6.7	2.3	6.1	2.2	5.5	1.3	5.3	

### Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$  (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$		$V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$		$V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.6	6	1.8	5.6	1.5	4	1.5	3.4	ns
	B	A	1.7	5.4	1.7	4.6	1.5	4	1.5	3.7	
$t_{en}$	$\overline{OE}$	A	1.7	5.7	2.2	5.5	2.2	5.3	2.2	5.1	ns
		B	3.1	6.1	2.5	5.6	2.2	5.3	1.9	4.2	
$t_{dis}$	$\overline{OE}$	A	1.2	5.8	1.9	5	1.4	3.6	1.3	3.3	ns
		B	2.4	6	3	5.2	1.4	3.6	1.2	3	

### Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$  (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$		$V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$		$V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.5	5.9	1.7	5.4	1.5	3.7	1.4	3.1	ns
	B	A	1.5	5.8	1.5	4.2	1.5	3.3	1.4	3.1	
$t_{en}$	$\overline{OE}$	A	1.6	4.9	2	4.5	2	4.3	1.9	4.1	ns
		B	2	5.1	2	4.6	2.2	5.2	1.9	4.1	
$t_{dis}$	$\overline{OE}$	A	1.3	6.9	2.1	5.5	1.6	3.8	1.5	3.5	ns
		B	2.3	5.5	1.9	4.5	1.3	3.5	1.2	3.5	

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**Operating Characteristics**

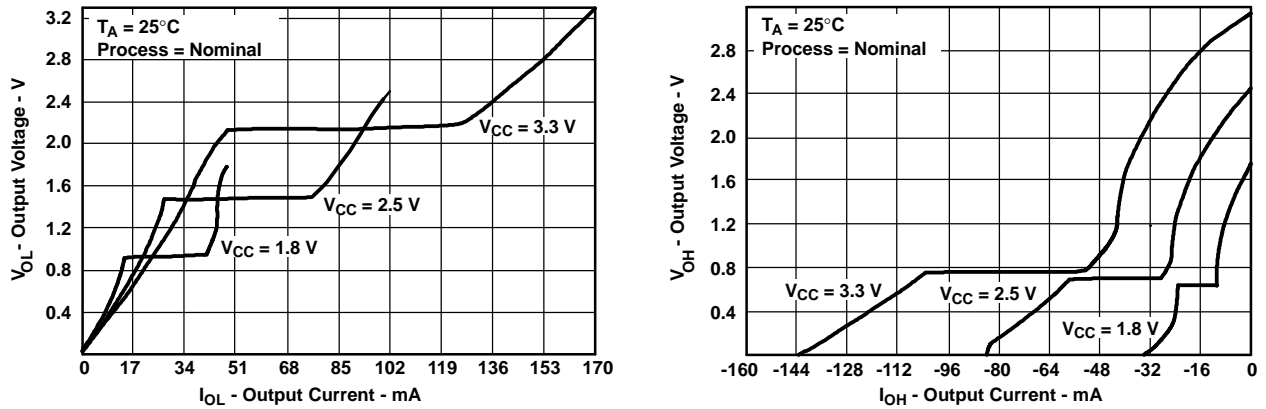
$V_{CCA}$  and  $V_{CCB} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT	
$C_{pdA}$ ( $V_{CCA}$ )	Power-dissipation capacitance per transceiver, A-port input, B-port output	$C_L = 0$ , $f = 10\text{ MHz}$	Outputs enabled	14	pF
			Outputs disabled	7	
	Power-dissipation capacitance per transceiver, B-port input, A-port output		Outputs enabled	20	
			Outputs disabled	7	
$C_{pdB}$ ( $V_{CCB}$ )	Power-dissipation capacitance per transceiver, A-port input, B-port output	$C_L = 0$ , $f = 10\text{ MHz}$	Outputs enabled	20	pF
			Outputs disabled	7	
	Power-dissipation capacitance per transceiver, B-port input, A-port output		Outputs enabled	14	
			Outputs disabled	7	



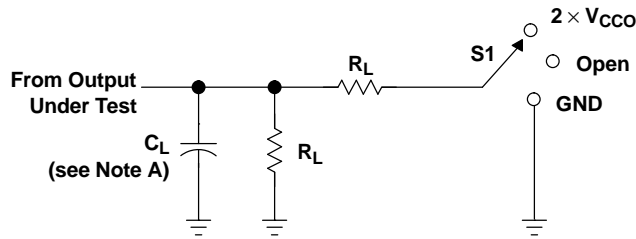
### Output Description

The dynamic output control (DOC™) circuitry is implemented, which, during the transition, initially lowers the output impedance to effectively drive the load and, subsequently, raises the impedance to reduce noise. Figure 1 shows typical  $V_{OL}$  vs  $I_{OL}$  and  $V_{OH}$  vs  $I_{OH}$  curves to illustrate the output impedance and drive capability of the circuit. At the beginning of the signal transition, the DOC circuit provides a maximum dynamic drive that is equivalent to a high-drive standard-output device. For more information, refer to the TI application reports, *AVC Logic Family Technology and Applications*, literature number SCEA006, and *Dynamic Output Control (DOC™) Circuitry Technology and Applications*, literature number SCEA009.



**Figure 1. Typical Output Voltage vs Output Current**

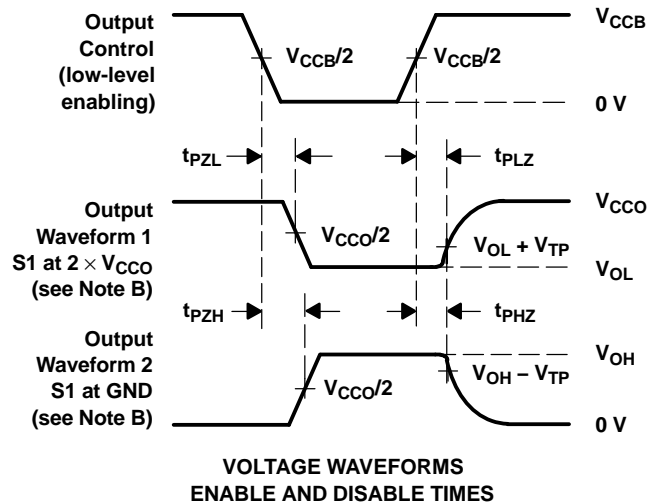
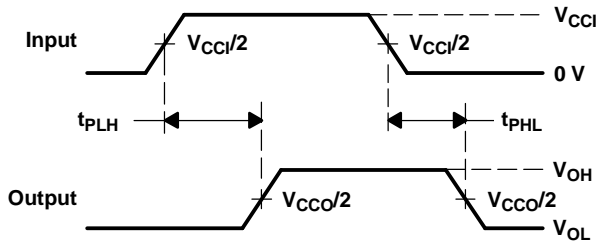
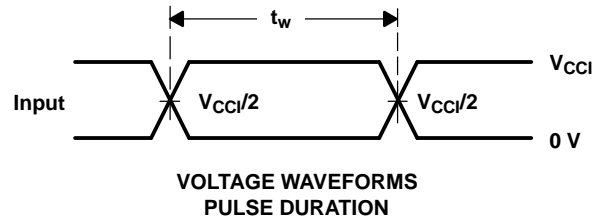
**PARAMETER MEASUREMENT INFORMATION**



**LOAD CIRCUIT**

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

$V_{CCO}$	$C_L$	$R_L$	$V_{TP}$
$1.5\text{ V} \pm 0.1\text{ V}$	15 pF	2 k $\Omega$	0.1 V
$1.8\text{ V} \pm 0.15\text{ V}$	30 pF	1 k $\Omega$	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	30 pF	500 $\Omega$	0.15 V
$3.3\text{ V} \pm 0.3\text{ V}$	30 pF	500 $\Omega$	0.3 V



- 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:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $dv/dt \geq 1\text{ V/ns}$ ,  $dv/dt \geq 1\text{ V/ns}$ .  
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.  $V_{CC1}$  is the  $V_{CC}$  associated with the input port.  
I.  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.

**Figure 2. 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)	Op Temp (°C)	Top-Side Markings (4)	Samples
74AVCB324245ZKER	ACTIVE	LFBGA	ZKE	96	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	-40 to 85	WD4245	<a href="#">Samples</a>
SN74AVCB324245KR	ACTIVE	LFBGA	GKE	96	1000	TBD	SNPB	Level-2-235C-1 YEAR	-40 to 85	WD4245	<a href="#">Samples</a>

(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.

**OBSOLETE:** 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.

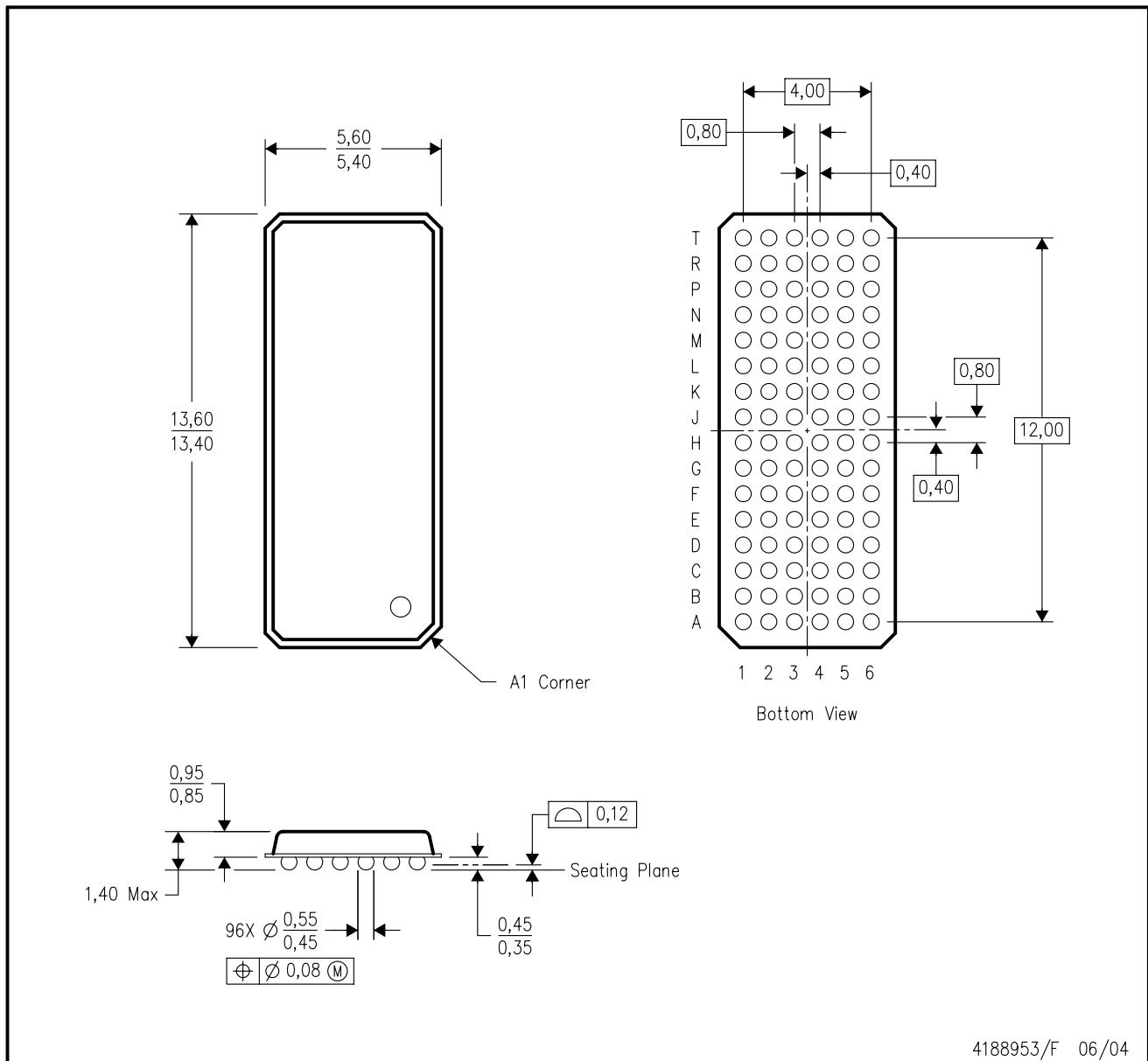
(4) Only one of markings shown within the brackets will appear on the physical device.

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GKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY

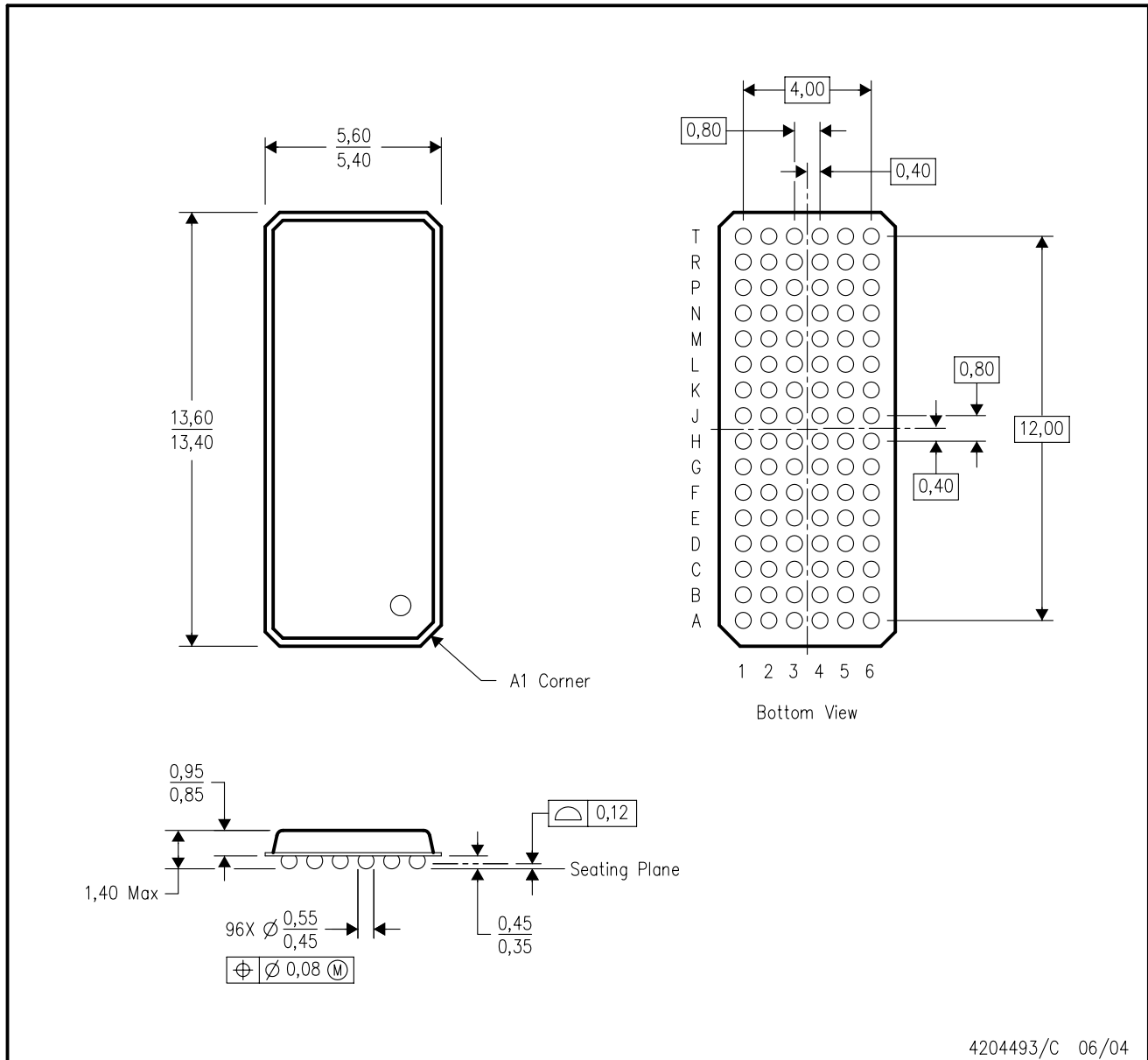


4188953/F 06/04

- 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 tin-lead (SnPb). Refer to the 96 ZKE package (drawing 4204493) for lead-free.

ZKE (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 lead-free. Refer to the 96 GKE package (drawing 4188953) for tin-lead (SnPb).

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