

## FEATURES

- Member of the Texas Instruments Widebus™ Family
- Operates From 1.65 V to 3.6 V
- Max  $t_{pd}$  of 4 ns at 3.3 V
- $\pm 12$ -mA Output Drive at 3.3 V
- Output Port Has Equivalent 26- $\Omega$  Series Resistors, So No External Resistors Are Required
- Designed to Comply With JEDEC 168-Pin and 200-Pin SDRAM Buffered DIMM Specification
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- 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

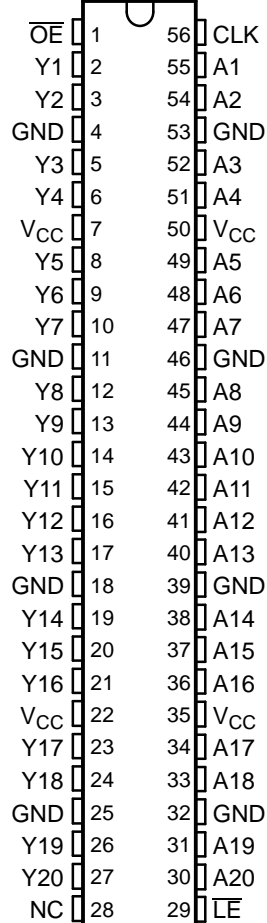
This 20-bit universal bus driver is designed for 1.65-V to 3.6-V  $V_{CC}$  operation.

Data flow from A to Y is controlled by the output-enable ( $\overline{OE}$ ) input. The device operates in the transparent mode when the latch-enable ( $\overline{LE}$ ) input is low. When  $\overline{LE}$  is high, the A data is latched if the clock (CLK) input is held at a high or low logic level. If  $\overline{LE}$  is high, the A data is stored in the latch/flip-flop on the low-to-high transition of CLK. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

The output port includes equivalent 26- $\Omega$  series resistors to reduce overshoot and undershoot.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  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.

DGG, DGV, OR DL PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP - DL	Tube	SN74ALVC162836DL	ALVC162836
		Tape and reel	SN74ALVC162836DLR	
	TSSOP - DGG	Tape and reel	SN74ALVC162836DGGR	ALVC162836
	TVSOP - DGV	Tape and reel	SN74ALVC162836DGVR	VC2836

(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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# SN74ALVC162836

## 20-BIT UNIVERSAL BUS DRIVER

### WITH 3-STATE OUTPUTS

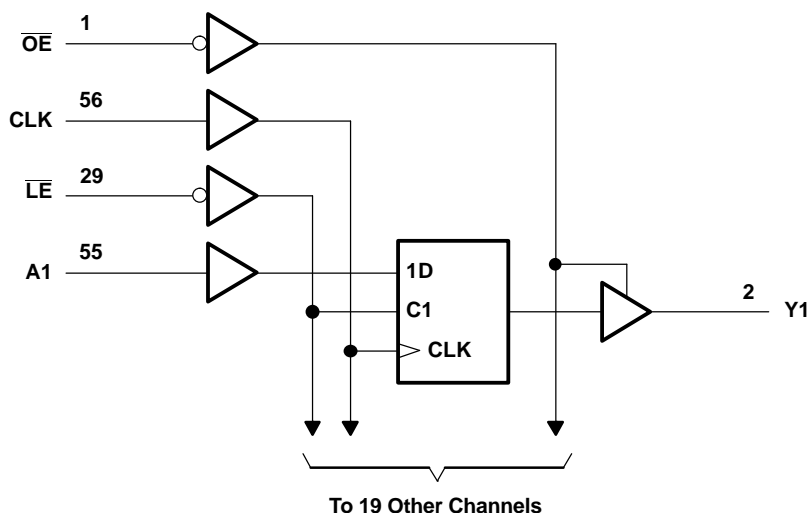
SCES129E—MARCH 1998—REVISED OCTOBER 2004

**FUNCTION TABLE**

INPUTS				OUTPUT Y
$\overline{OE}$	$\overline{LE}$	CLK	A	
H	X	X	X	Z
L	L	X	L	L
L	L	X	H	H
L	H	$\uparrow$	L	L
L	H	$\uparrow$	H	H
L	H	L or H	X	$Y_0^{(1)}$

(1) Output level before the indicated steady-state input conditions were established, provided that CLK is high before  $\overline{LE}$  goes high

**LOGIC DIAGRAM (POSITIVE LOGIC)**



## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

			MIN	MAX	UNIT	
V <sub>CC</sub>	Supply voltage range		-0.5	4.6	V	
V <sub>I</sub>	Input voltage range <sup>(2)</sup>		-0.5	4.6	V	
V <sub>O</sub>	Output voltage range <sup>(2)(3)</sup>		-0.5	V <sub>CC</sub> + 0.5	V	
I <sub>IK</sub>	Input clamp current	V <sub>I</sub> < 0			-50	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0			-50	mA
I <sub>O</sub>	Continuous output current				±50	mA
Continuous current through each V <sub>CC</sub> or GND					±100	mA
θ <sub>JA</sub>	Package thermal impedance <sup>(4)</sup>	DGG package			64	°C/W
		DGV package			48	
		DL package			56	
T <sub>stg</sub>	Storage temperature range		-65	150	°C	

- 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.
- The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- This value is limited to 4.6 V maximum.
- The package thermal impedance is calculated in accordance with JESD 51-7.

## RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage	1.65	3.6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.65 \times V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7	
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2	
$V_{IL}$	Low-level input voltage	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.7	
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	0.8	
$V_I$	Input voltage	0	3.6	V
$V_O$	Output voltage	0	$V_{CC}$	V
$I_{OH}$	High-level output current	$V_{CC} = 1.65\text{ V}$	-2	mA
		$V_{CC} = 2.3\text{ V}$	-6	
		$V_{CC} = 2.7\text{ V}$	-8	
		$V_{CC} = 3\text{ V}$	-12	
$I_{OL}$	Low-level output current	$V_{CC} = 1.65\text{ V}$	2	mA
		$V_{CC} = 2.3\text{ V}$	6	
		$V_{CC} = 2.7\text{ V}$	8	
		$V_{CC} = 3\text{ V}$	12	
$\Delta t/\Delta v$	Input transition rise or fall rate		10	ns/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 <sup>(1)</sup>	MAX	UNIT
$V_{OH}$	$I_{OH} = -100\text{ }\mu\text{A}$	1.65 V to 3.6 V	$V_{CC} - 0.2$			V
	$I_{OH} = -2\text{ mA}$	1.65 V	1.2			
	$I_{OH} = -4\text{ mA}$	2.3 V	1.9			
	$I_{OH} = -6\text{ mA}$	2.3 V	1.7			
		3 V	2.4			
	$I_{OH} = -8\text{ mA}$	2.7 V	2			
	$I_{OH} = -12\text{ mA}$	3 V	2			
$V_{OL}$	$I_{OL} = 100\text{ }\mu\text{A}$	1.65 V to 3.6 V			0.2	V
	$I_{OL} = 2\text{ mA}$	1.65 V			0.45	
	$I_{OL} = 4\text{ mA}$	2.3 V			0.4	
	$I_{OL} = 6\text{ mA}$	2.3 V			0.55	
		3 V			0.55	
	$I_{OL} = 8\text{ mA}$	2.7 V			0.6	
	$I_{OL} = 12\text{ mA}$	3 V			0.8	
$I_I$	$V_I = V_{CC}$ or GND	3.6 V			$\pm 5$	$\mu\text{A}$
$I_{OZ}$	$V_O = V_{CC}$ or GND	3.6 V			$\pm 10$	$\mu\text{A}$
$I_{CC}$	$V_I = V_{CC}$ or GND, $I_O = 0$	3.6 V			40	$\mu\text{A}$
$\Delta I_{CC}$	One input at $V_{CC} - 0.6\text{ V}$ , Other inputs at $V_{CC}$ or GND	3 V to 3.6 V			750	$\mu\text{A}$
$C_i$	Control inputs	$V_I = V_{CC}$ or GND	3.3 V	5		pF
	Data inputs			5.5		
$C_o$	Outputs	$V_O = V_{CC}$ or GND	3.3 V	7.5		pF

(1) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

# SN74ALVC162836

## 20-BIT UNIVERSAL BUS DRIVER

### WITH 3-STATE OUTPUTS

SCES129E—MARCH 1998—REVISED OCTOBER 2004

## TIMING REQUIREMENTS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

				V <sub>CC</sub> = 1.8 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 2.7 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency			(1)		150		150		150		MHz
t <sub>w</sub>	Pulse duration	LE low		(1)		3.3		3.3		3.3		ns
		CLK high or low		(1)		3.3		3.3		3.3		
t <sub>su</sub>	Setup time	Data before CLK↑		(1)		1.4		1.7		1.5		ns
		Data before LE↑	CLK high	(1)		1.2		1.6		1.3		
			CLK low	(1)		1.4		1.5		1.2		
t <sub>h</sub>	Hold time	Data after CLK↑		(1)		0.9		0.9		0.9		ns
		Data after LE↑	CLK high or low	(1)		1.1		1.1		1.1		

(1) This information was not available at the time of publication.

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\text{ V}$		$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	TYP	MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			(1)		150		150		150		MHz
$t_{\text{pd}}$	A	Y	(1)		1	4.4	4.6		1.2	4	ns
	$\overline{\text{LE}}$		(1)		1.1	5.8	6.1		1.4	5.1	
	CLK		(1)		1	5.2	5.5		1.1	5	
$t_{\text{en}}$	$\overline{\text{OE}}$	Y	(1)		1.1	6.4	6.5		1.2	5.5	ns
$t_{\text{dis}}$	$\overline{\text{OE}}$	Y	(1)		1	4.7	5.2		1.7	5.1	ns

(1) This information was not available at the time of publication.

## SWITCHING CHARACTERISTICS

from 0°C to 65°C,  $C_L = 50\text{ pF}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 3.3\text{ V} \pm 0.15\text{ V}$		UNIT
			MIN	MAX	
$t_{\text{pd}}$	A	Y	1	4	ns
	CLK		1.7	4.5	

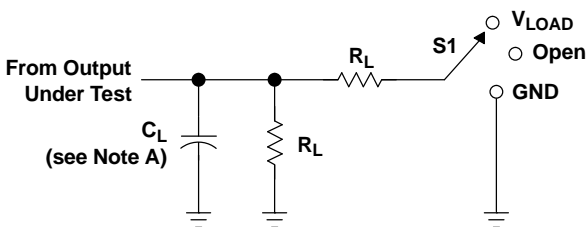
## OPERATING CHARACTERISTICS

$T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
			TYP	TYP	TYP	
$C_{\text{pd}}$	Power dissipation capacitance	$C_L = 0, \quad f = 10\text{ MHz}$	(1)	31	36	pF
	Outputs enabled		(1)	7	11	

(1) This information was not available at the time of publication.

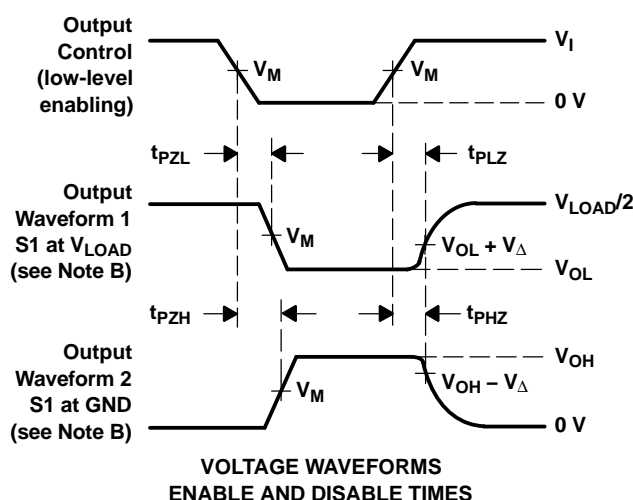
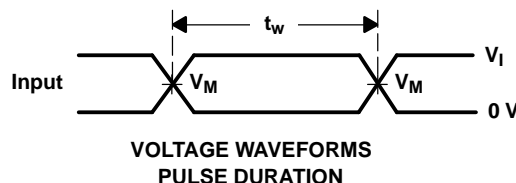
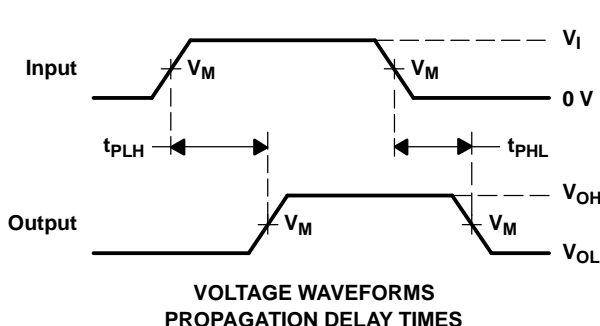
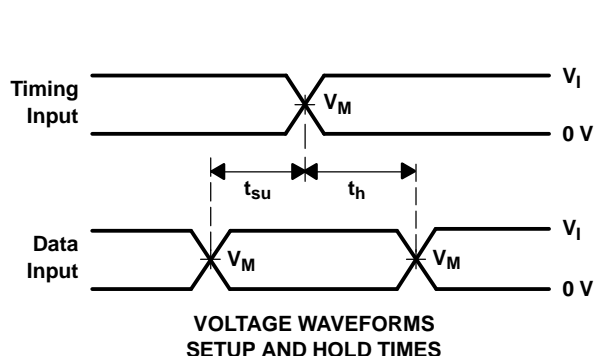
## PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

TEST	S1
$t_{pd}$	Open
$t_{PLZ}/t_{PZL}$	$V_{LOAD}$
$t_{PHZ}/t_{PHZ}$	GND

$V_{CC}$	INPUT		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
1.8 V	$V_{CC}$	$\leq 2$ ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
2.5 V $\pm$ 0.2 V	$V_{CC}$	$\leq 2$ ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
2.7 V	2.7 V	$\leq 2.5$ ns	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
3.3 V $\pm$ 0.3 V	2.7 V	$\leq 2.5$ ns	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V



- NOTES:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

## PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
74ALVC162836DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVC162836DGVRE4	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVC162836DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVC162836DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVC162836DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVC162836DGV	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVC162836DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVC162836DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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## DGV (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

DL (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
 D. Falls within JEDEC MO-118



## DGG (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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