

## FEATURES

- Member of the Texas Instruments Widebus™ Family
- Operates From 1.65 V to 3.6 V
- Max  $t_{pd}$  of 2 ns at 3.3 V
- $\pm 12$ -mA Output Drive at 3.3 V
- Ideal for Use in PC100 Register DIMM, Revision 1.1
- Output Port Has Equivalent 26- $\Omega$  Series Resistors, So No External Resistors Are Required
- 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

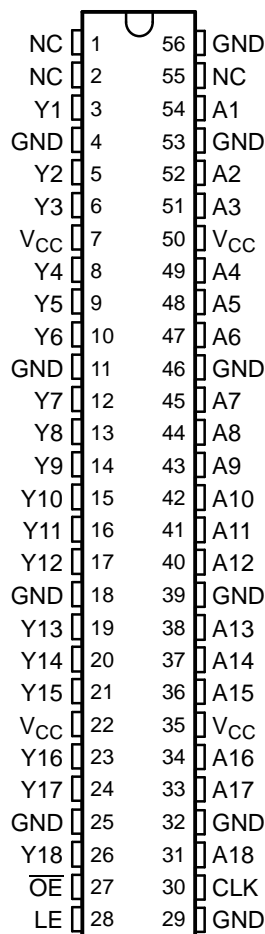
This 18-bit universal bus driver is designed for 1.65-V to 3.6-V  $V_{CC}$  operation.

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 (LE) input is high. When LE is low, the A data is latched if the clock (CLK) input is held at a high or low logic level. If LE is low, 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.

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.

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

## 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	SN74ALVC162835DL	ALVC162835
		Tape and reel	SN74ALVC162835DLR	
	TSSOP - DGG	Tape and reel	SN74ALVC162835DGGR	ALVC162835
	TVSOP - DGV	Tape and reel	SN74ALVC162835DGV	VC2835

(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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Widebus is a trademark of Texas Instruments.

**SN74ALVC162835**  
**18-BIT UNIVERSAL BUS DRIVER**  
**WITH 3-STATE OUTPUTS**

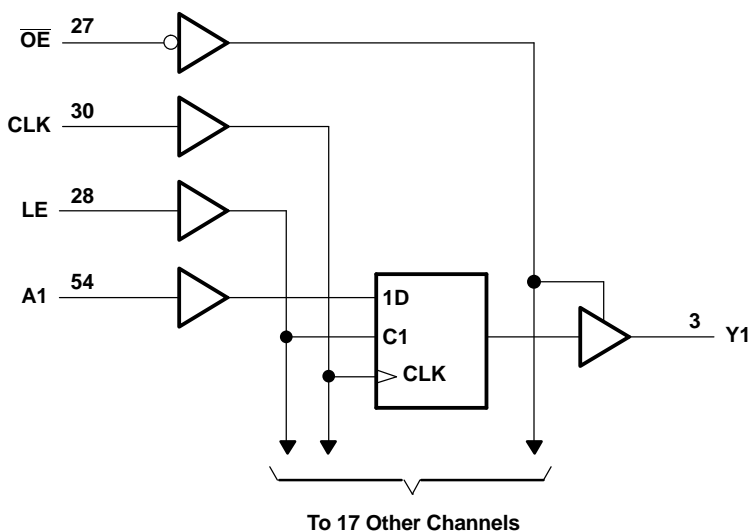
SCES126H—FEBRUARY 1998—REVISED SEPTEMBER 2004

**FUNCTION TABLE**

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

(1) Output level before the indicated steady-state input conditions were established

**LOGIC DIAGRAM (POSITIVE LOGIC)**



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

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

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage range	-0.5	4.6	V
$V_I$	Input voltage range <sup>(2)</sup>	-0.5	4.6	V
$V_O$	Output voltage range <sup>(2)(3)</sup>	-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
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>	DGG package	64	°C/W
		DGV package	48	
		DL package	56	
$T_{stg}$	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) This value is limited to 4.6 V maximum.
- (4) 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.

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**18-BIT UNIVERSAL BUS DRIVER**  
**WITH 3-STATE OUTPUTS**

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**ELECTRICAL CHARACTERISTICS**

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP <sup>(1)</sup>	MAX	UNIT	
V <sub>OH</sub>	I <sub>OH</sub> = -100 μA	1.65 V to 3.6 V	V <sub>CC</sub> - 0.2			V	
	I <sub>OH</sub> = -2 mA	1.65 V	1.2				
	I <sub>OH</sub> = -4 mA	2.3 V	1.9				
	I <sub>OH</sub> = -6 mA	2.3 V	1.7				
		3 V	2.4				
	I <sub>OH</sub> = -8 mA	2.7 V	2				
V <sub>OL</sub>	I <sub>OL</sub> = 100 μA	1.65 V to 3.6 V			0.2	V	
	I <sub>OL</sub> = 2 mA	1.65 V			0.45		
	I <sub>OL</sub> = 4 mA	2.3 V			0.4		
	I <sub>OL</sub> = 6 mA	2.3 V			0.55		
		3 V			0.55		
	I <sub>OL</sub> = 8 mA	2.7 V			0.6		
	I <sub>OL</sub> = 12 mA	3 V			0.8		
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.6 V			±5	μA	
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	3.6 V			±10	μA	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	3.6 V			40	μA	
ΔI <sub>CC</sub>	One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND	3 V to 3.6 V			750	μA	
C <sub>i</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or GND			3.5	pF	
	Data inputs				5		
C <sub>o</sub>	Outputs	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V			7	pF

(1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

**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 high		(1)		3.3		3.3		ns	
		CLK high or low		(1)		3.3		3.3			
t <sub>su</sub>	Setup time	Data before CLK↑		(1)		2.2		2.1		ns	
		Data before LE↓	CLK high		(1)		1.9		1.6		
			CLK low		(1)		1.3		1.1		
t <sub>h</sub>	Hold time	Data after CLK↑		(1)		0.6		0.6		ns	
		Data after LE↓	CLK high or low		(1)		1.4		1.7		

(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	
$f_{max}$			(1)		150		150		150		MHz
$t_{pd}$	A	Y	(1)		1 5		5		1 4.2		ns
	LE		(1)		1.3 5.9		5.8		1.3 5.1		
	CLK		(1)		1.4 6.3		6.1		1.4 5.4		
$t_{en}$	$\overline{OE}$	Y	(1)		1.4 6.3		6.5		1.1 5.5		ns
$t_{dis}$	$\overline{OE}$	Y	(1)		1 4.9		4.9		1.3 4.5		ns

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

## SWITCHING CHARACTERISTICS

from 0°C to 85°C,  $C_L = 0\text{ pF}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 3.3\text{ V} \pm 0.15\text{ V}$		UNIT
			MIN	MAX	
$t_{pd}^{(1)}$	A	Y	0.9	2	ns
	CLK		1.4	2.9	

(1) Texas Instruments SPICE simulation data

## 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	
$t_{pd}$	A	Y	1	4	ns
	CLK		1.9	5	

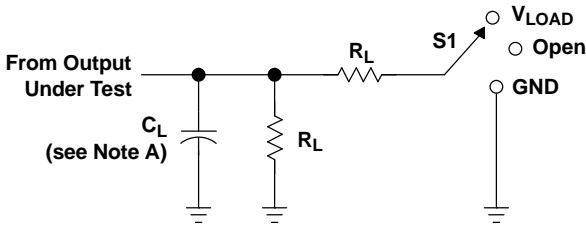
## OPERATING CHARACTERISTICS

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

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	
$C_{pd}$	Power dissipation capacitance	Outputs enabled	(1)	35.5	40	pF
		Outputs disabled	(1)	12.5	14	

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

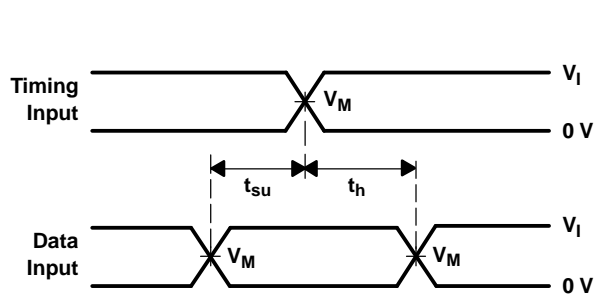
PARAMETER MEASUREMENT INFORMATION



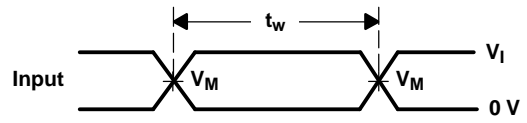
LOAD CIRCUIT

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

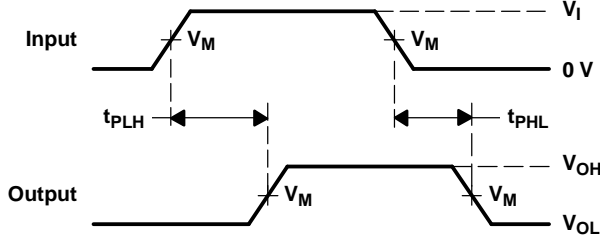
$V_{CC}$	INPUT		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
1.8 V	$V_{CC}$	$\leq 2$ ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5 V \pm 0.2 V$	$V_{CC}$	$\leq 2$ ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
2.7 V	2.7 V	$\leq 2.5$ ns	1.5 V	6 V	50 pF	500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



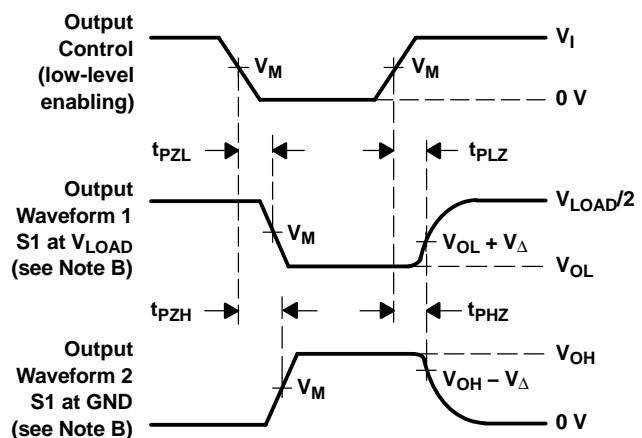
VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES

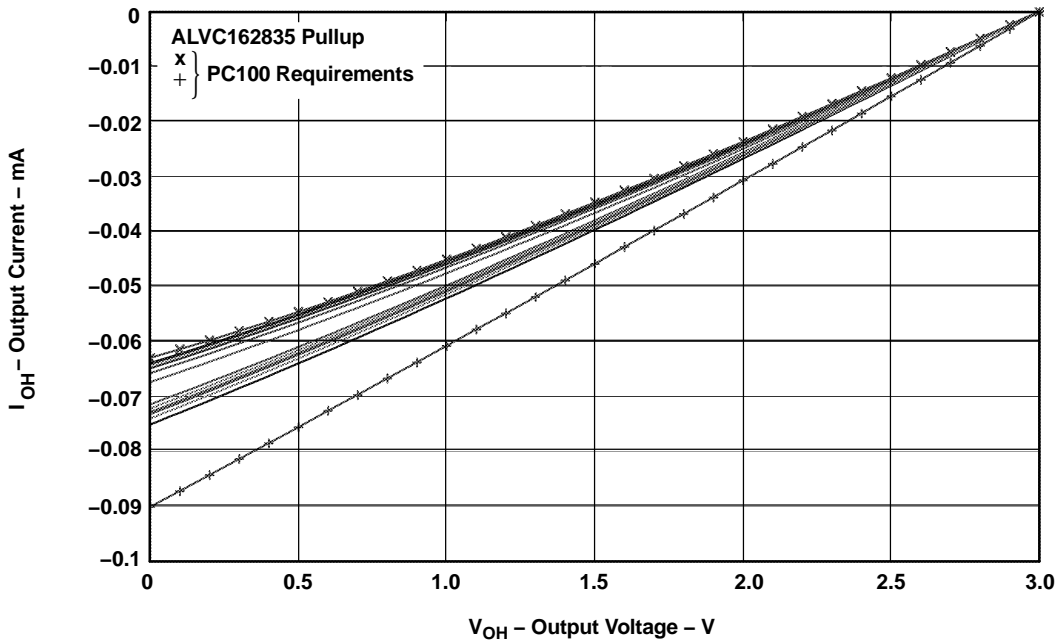


VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES

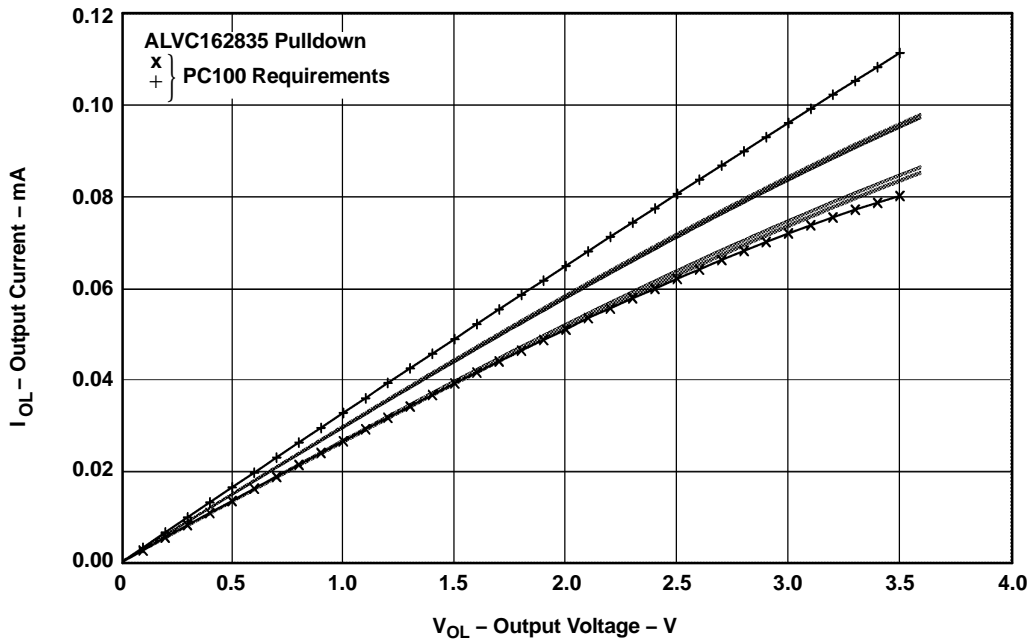
- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
 C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ .  
 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

**TYPICAL CHARACTERISTICS**



**Figure 2. IV Characteristics - Pullup**



**Figure 3. IV Characteristics - Pulldown**

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74ALVC162835DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVC162835	Samples

(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) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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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
SN74ALVC162835DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	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)
SN74ALVC162835DGGR	TSSOP	DGG	56	2000	367.0	367.0	45.0

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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Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
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