

FEATURES

- Member of the Texas Instruments Widebus™ Family
- UBT™ Transceiver Combines D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, Clocked, or Clock-Enable Mode
- Operates From 1.65 V to 3.6 V
- Max t_{pd} of 3.2 ns at 3.3 V
- ± 24 -mA Output Drive at 3.3 V
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Performance Tested Per JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)

DESCRIPTION/ORDERING INFORMATION

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

Data flow in each direction is controlled by output-enable (\overline{OEAB} and \overline{OEBA}) and clock-enable ($\overline{CLKENBA}$) inputs. For the A-to-B data flow, the data flows through a single buffer. The B-to-A data can flow through a four-stage pipeline register path, or through a single register path, depending on the state of the select (SEL) input.

Data is stored in the internal registers on the low-to-high transition of the clock (CLK) input, provided that the appropriate $\overline{CLKENBA}$ input is low. The B-to-A data transfer is synchronized with CLK.

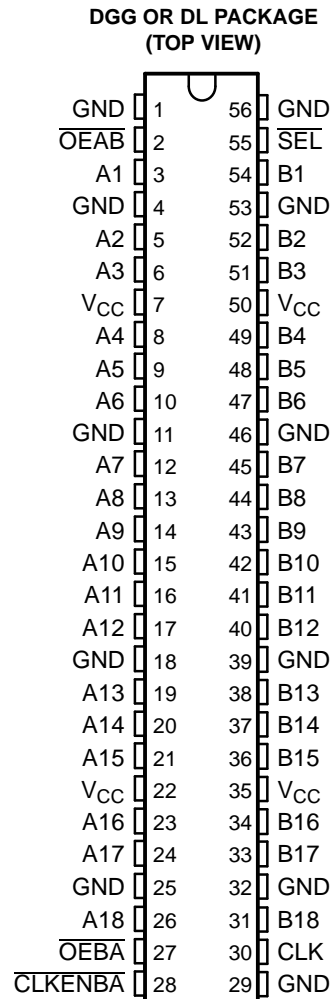
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40 to 85°C	SSOP - DL	Tube	SN74ALVCH16524DL	ALVCH16524
		Tape and reel	SN74ALVCH16524DLR	
	TSSOP - DGG	Tape and reel	SN74ALVCH16524DGGR	ALVCH16524

(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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SN74ALVCH16524
18-BIT REGISTERED BUS TRANSCEIVER
WITH 3-STATE OUTPUTS

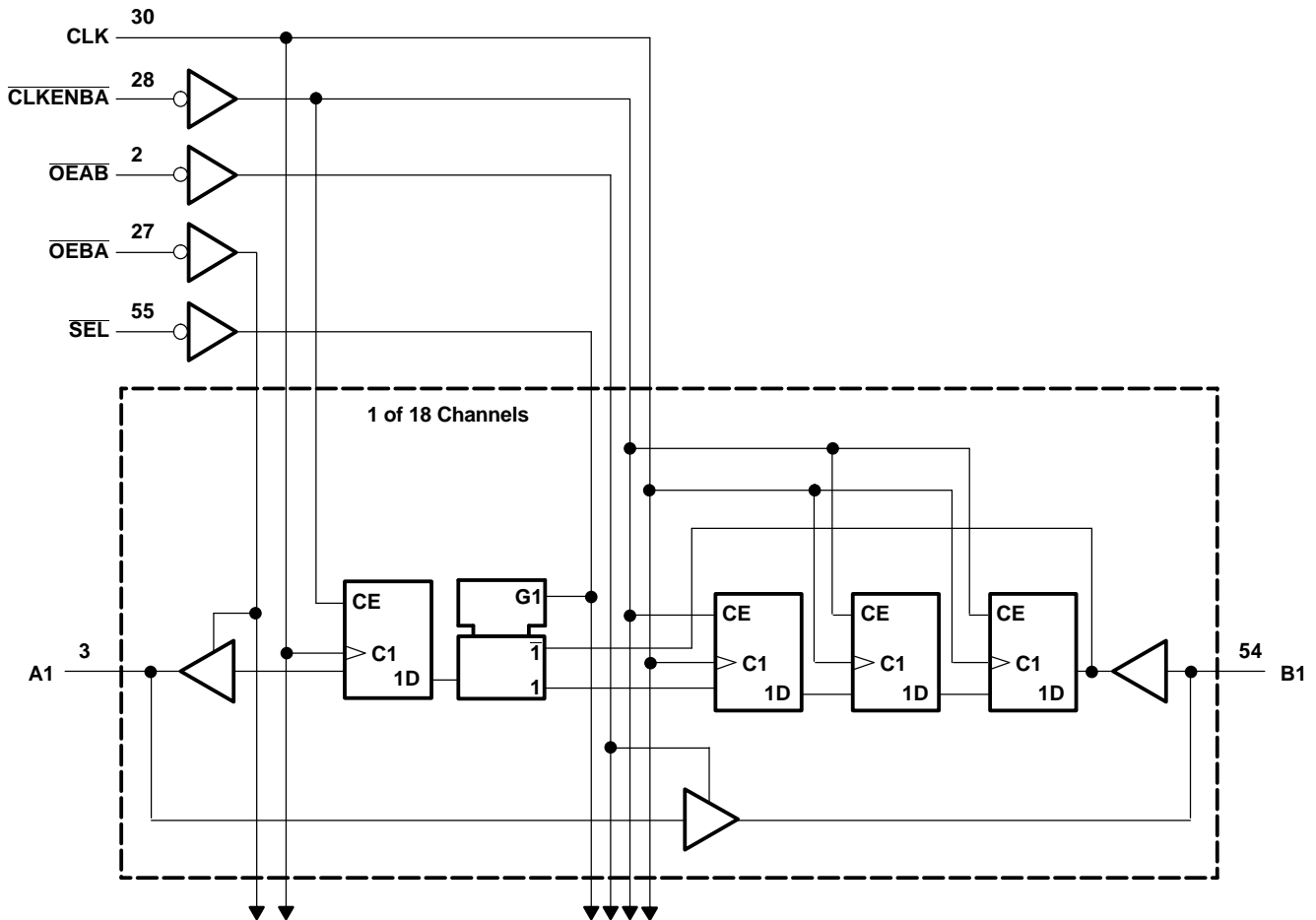
SCES080E—JULY 1996—REVISED OCTOBER 2004

FUNCTION TABLE
B-TO-A STORAGE (OEBA = L)

INPUTS				OUTPUT A
CLKENBA	CLK	SEL	B	
H	X	X	X	A ₀ ⁽¹⁾
L	↑	H	L	L
L	↑	H	H	H
L	↑	L	L	L ⁽²⁾
L	↑	L	H	H ⁽²⁾

- (1) Output level before the indicated steady-state input conditions were established
- (2) Four positive CLK edges are needed to propagate data from B to A when SEL is low.

LOGIC DIAGRAM (POSITIVE LOGIC)



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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	Except I/O ports ⁽²⁾	4.6	V
		I/O ports ⁽²⁾⁽³⁾	$V_{CC} + 0.5$	
V_O	Output voltage range ⁽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	
θ_{JA}	Package thermal impedance ⁽⁴⁾	DGG package	64	°C/W
		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⁽¹⁾

		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	V_{CC}	V
V_O	Output voltage	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 1.65 \text{ V}$	-4	mA
		$V_{CC} = 2.3 \text{ V}$	-12	
		$V_{CC} = 2.7 \text{ V}$	-12	
		$V_{CC} = 3 \text{ V}$	-24	
I_{OL}	Low-level output current	$V_{CC} = 1.65 \text{ V}$	4	mA
		$V_{CC} = 2.3 \text{ V}$	12	
		$V_{CC} = 2.7 \text{ V}$	12	
		$V_{CC} = 3 \text{ V}$	24	
$\Delta t/\Delta v$	Input transition rise or fall rate		10	ns/V
T_A	Operating free-air temperature	-40	85	°C

- (1) All unused control 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.

SN74ALVCH16524

18-BIT REGISTERED BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCES080E—JULY 1996—REVISED OCTOBER 2004

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	1.65 V to 3.6 V	V _{CC} - 0.2			V
		I _{OH} = -4 mA	1.65 V	1.2			
		I _{OH} = -6 mA	2.3 V	2			
		I _{OH} = -12 mA	2.3 V	1.7			
			2.7 V	2.2			
			3 V	2.4			
V _{OL}		I _{OL} = 100 μA	1.65 V to 3.6 V	0.2			V
		I _{OL} = 4 mA	1.65 V	0.45			
		I _{OL} = 6 mA	2.3 V	0.4			
		I _{OL} = 12 mA	2.3 V	0.7			
			2.7 V	0.4			
		I _{OL} = 24 mA	3 V	0.55			
I _I		V _I = V _{CC} or GND	3.6 V	±5			μA
I _{I(hold)}		V _I = 0.58 V	1.65 V	25			μA
		V _I = 1.07 V	1.65 V	-25			
		V _I = 0.7 V	2.3 V	45			
		V _I = 1.7 V	2.3 V	-45			
		V _I = 0.8 V	3 V	75			
		V _I = 2 V	3 V	-75			
		V _I = 0 to 3.6 V ⁽²⁾	3.6 V	±500			
I _{OZ} ⁽³⁾		V _O = V _{CC} or GND	3.6 V	±10			μA
I _{CC}		V _I = V _{CC} or GND, I _O = 0	3.6 V	40			μA
ΔI _{CC}		One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND	3 V to 3.6 V	750			μA
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V	3			pF
C _{io}	A or B ports	V _O = V _{CC} or GND	3.3 V	7			pF

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

(2) This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

(3) For I/O ports, the parameter I_{OZ} includes the input leakage current.

TIMING REQUIREMENTS

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

		V _{CC} = 1.8 V		V _{CC} = 2.5 V ± 0.2 V		V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency	(1)		120		125		150		MHz
t _w	Pulse duration, CLK high or low	(1)		3.2		3.2		3		ns
t _{su}	Setup time	B data before CLK↑		(1)		1.5		1.2		ns
		$\overline{\text{SEL}}$ before CLK↑		(1)		2.7		2.4		
		CLKENB $\overline{\text{A}}$ before CLK↑		(1)		2.7		2.6		
t _h	Hold time	B data after CLK↑		(1)		1		0.6		ns
		$\overline{\text{SEL}}$ after CLK↑		(1)		0.5		0.2		
		CLKENB $\overline{\text{A}}$ after CLK↑		(1)		0.1		0.1		

(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_{max}			(1)		120		125		150		MHz
t_{pd}	A	B		(1)	1	3.9	3.8		1	3.2	ns
	CLK	A		(1)	1	6.1	6.2		1	5.2	
t_{en}	\overline{OEAB} or \overline{OEBA}	A or B		(1)	1	6.1	6.1		1	5.1	ns
t_{dis}	\overline{OEAB} or \overline{OEBA}	A or B		(1)	1	6.3	5.4		1	4.9	ns

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

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	$C_L = 50\text{ pF}, f = 10\text{ MHz}$	(1)	160	160	pF
	capacitance		(1)	160	160	

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

PARAMETER MEASUREMENT INFORMATION



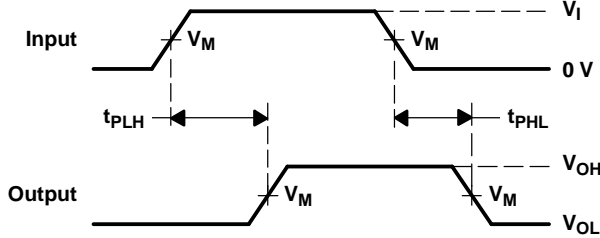
LOAD CIRCUIT

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

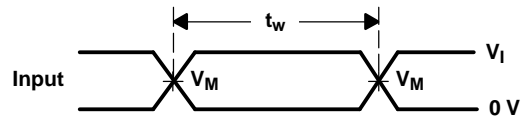
V_{CC}	INPUT		V_M	V_{LOAD}	C_L	R_L	V_{Δ}
	V_I	t_r/t_f					
$1.8\text{ V} \pm 0.15\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k Ω	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	$\leq 2.5\text{ ns}$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



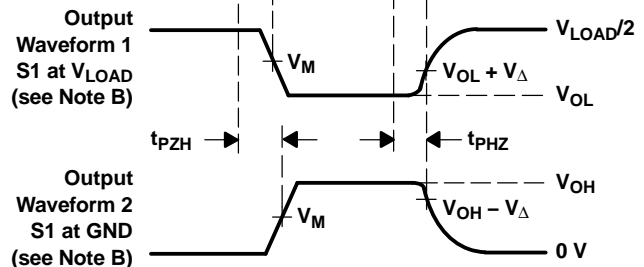
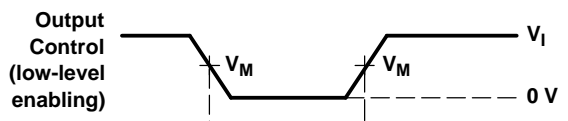
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$.
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⁾
74ALVCH16524DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCH16524DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCH16524DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVCH16524DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVCH16524DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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.

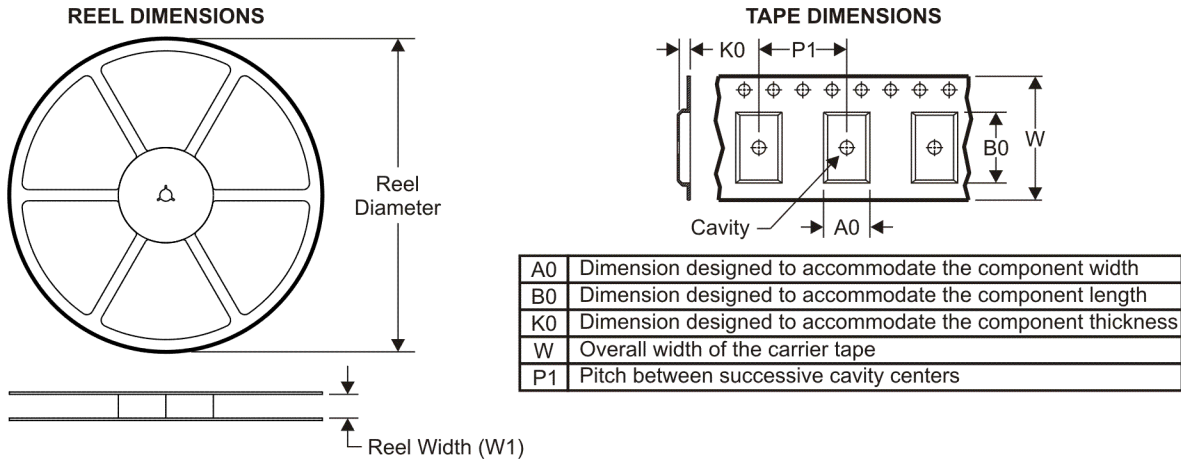
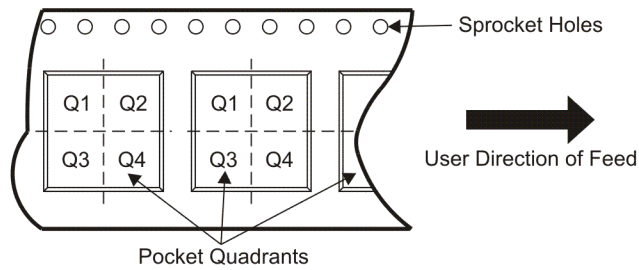
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

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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
SN74ALVCH16524DGGR	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)
SN74ALVCH16524DGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0

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.
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 C. Body dimensions do not include mold protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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