TEXAS INSTRUMENTS

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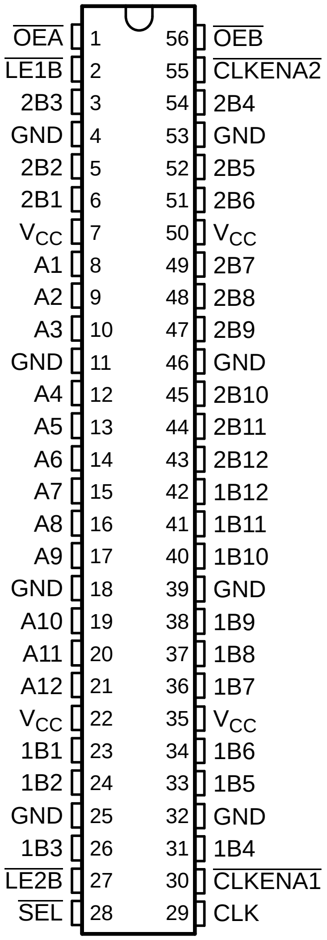
SN74ALVCH16271
12-BIT TO 24-BIT MULTIPLEXED BUS EXCHANGER WITH 3-STATE OUTPUTS

SCES017G–JULY 1995–REVISED SEPTEMBER 2004

FEATURES

- **Member of the Texas Instruments Widebus™ Family**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **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)**

DGG OR DL PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

This 12-bit to 24-bit bus exchanger is designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74ALVCH16271 is intended for applications in which two separate data paths must be multiplexed onto, or demultiplexed from, a single data path. This device is particularly suitable as an interface between conventional DRAMs and high-speed microprocessors.

A data is stored in the internal A-to-B registers on the low-to-high transition of the clock (CLK) input, provided that the clock-enable ($\overline{\mathrm{CLKENA}}$) inputs are low. Proper control of these inputs allows two sequential 12-bit words to be presented as a 24-bit word on the B port.

Transparent latches in the B-to-A path allow asynchronous operation to maximize memory access throughput. These latches transfer data when the latch-enable ($\overline{\mathrm{LE}}$) inputs are low. The select ($\overline{\mathrm{SEL}}$) line selects 1B or 2B data for the A outputs. Data flow is controlled by the active-low output enables ($\overline{\mathrm{OEA}}$, $\overline{\mathrm{OEB}}$).

To ensure the high-impedance state during power up or power down, the output enables 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°C to 85°C	SSOP - DL	Tube	SN74ALVCH16271DL	ALVCH16271
		Tape and reel	SN74ALVCH16271DLR	
	TSSOP - DGG	Tape and reel	SN74ALVCH16271DGGR	ALVCH16271

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

Widebus is a trademark of Texas Instruments.

FUNCTION TABLES

OUTPUT ENABLE

INPUTS		OUTPUTS	
$\overline{\text{OEA}}$	$\overline{\text{OEB}}$	A	1B, 2B
H	H	Z	Z
H	L	Z	Active
L	H	Active	Z
L	L	Active	Active

A-TO-B STORAGE ($\overline{\text{OEB}}$ = L)

INPUTS				OUTPUTS	
$\overline{\text{CLKENA1}}$	$\overline{\text{CLKENA2}}$	CLK	A	1B	2B
H	H	X	X	$1B_0$ (1)	$2B_0$ (1)
L	X	↑	L	L	X
L	X	↑	H	H	X
X	L	↑	L	X	L
X	L	↑	H	A_0	H

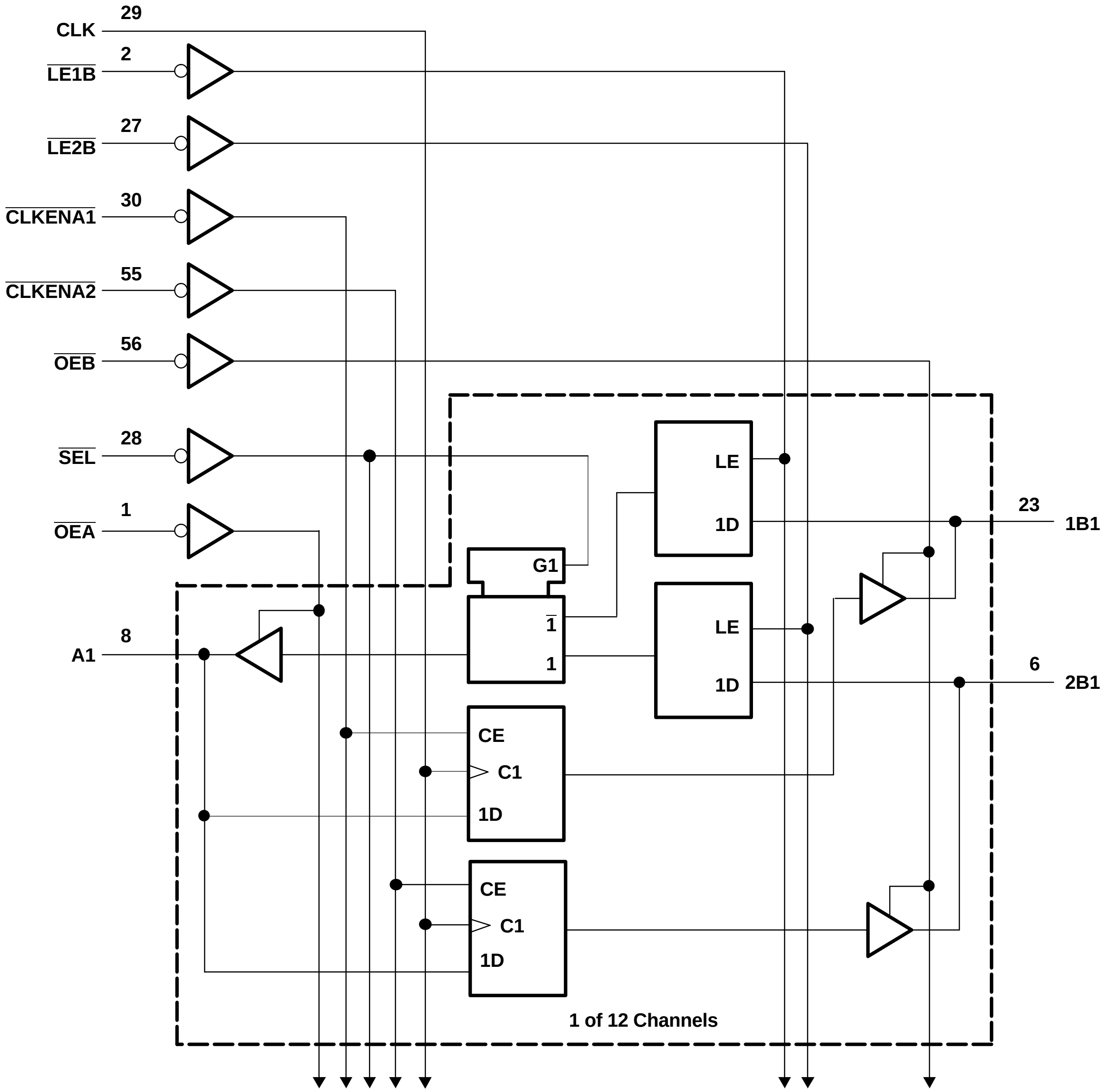
(1) Output level before the indicated steady-state input conditions were established

B-TO-A STORAGE ($\overline{\text{OEA}}$ = L)

INPUTS				OUTPUT A
$\overline{\text{LE}}$	$\overline{\text{SEL}}$	1B	2B	
H	X	X	X	A_0 (1)
H	X	X	X	A_0 (1)
L	H	L	X	L
L	H	H	X	H
L	L	X	L	L
L	L	X	H	H

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

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)	-0.5	4.6	V
		I/O ports(2)(3)	-0.5	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	mA
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 V to 1.95 V	0.65 × V_{CC}		V
		V_{CC} = 2.3 V to 2.7 V	1.7		
		V_{CC} = 2.7 V to 3.6 V	2		
V_{IL}	Low-level input voltage	V_{CC} = 1.65 V to 1.95 V		0.35 × V_{CC}	V
		V_{CC} = 2.3 V to 2.7 V		0.7	
		V_{CC} = 2.7 V to 3.6 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 V		-4	mA
		V_{CC} = 2.3 V		-12	
		V_{CC} = 2.7 V		-12	
		V_{CC} = 3 V		-24	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4	mA
		V_{CC} = 2.3 V		12	
		V_{CC} = 2.7 V		12	
		V_{CC} = 3 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.

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			
	I_{OH} = -24 mA	3 V	2			
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		3.5		pF
C_{io} A or B ports	V_O = V_{CC} or GND	3.3 V		9		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 through Figure 3)

			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	
f_{clock}	Clock frequency			130		130		130	MHz
t_w	Pulse duration, CLK high or low		3.3		3.3		3.3		ns
t_{su}	Setup time	A before CLK↑	2.6		2.1		1.7		ns
		B before $\overline{\text{LE}}$	1.7		1.5		1.3		
		$\overline{\text{CLKEN}}$ before CLK↑	1.6		1.3		1		
t_h	Hold time	A after CLK↑	0.6		0.6		0.7		ns
		B after $\overline{\text{LE}}$	0.9		0.9		1.1		
		$\overline{\text{CLKEN}}$ after CLK↑	1		0.9		0.9		

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 through Figure 3)

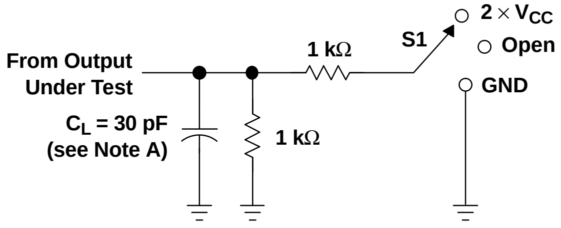
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 1.8 V	V_{CC} = 2.5 V ± 0.2 V		V_{CC} = 2.7 V		V_{CC} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}				130		130		130		MHz
t_{pd}	CLK	B	8	1	6.2		5	1	4.3	ns
	B	A	7	1	5.3		4.7	1.4	4	
	$\overline{\text{LE}}$		7	1	6		5.9	1.4	4.8	
	$\overline{\text{SEL}}$		7	1.1	6.4		6.2	1.3	5.2	
t_{en}	$\overline{\text{OEB}}$ or $\overline{\text{OEA}}$	B or A	8	1	6		6.1	1	5.1	ns
t_{dis}	$\overline{\text{OEB}}$ or $\overline{\text{OEA}}$	B or A	7	1.4	5.4		4.6	1.7	4.2	ns

OPERATING CHARACTERISTICS

T_A = 25°C

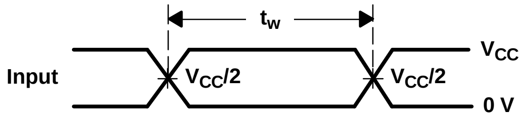
PARAMETER				TEST CONDITIONS	V_{CC} = 2.5 V	V_{CC} = 3.3 V	UNIT
					TYP	TYP	
C_{pd}	Power dissipation capacitance	A to B	Outputs enabled	C_L = 0, f = 10 MHz	92	105	pF
			Outputs disabled		61	76	
		B to A	Outputs enabled		39	43	
			Outputs disabled		11	13	

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 1.8 V

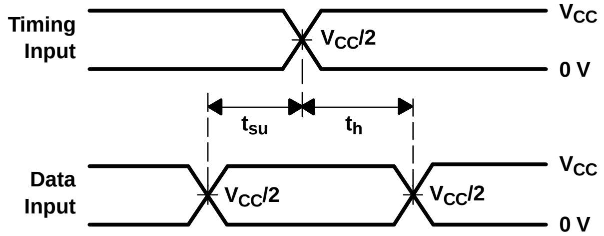


LOAD CIRCUIT

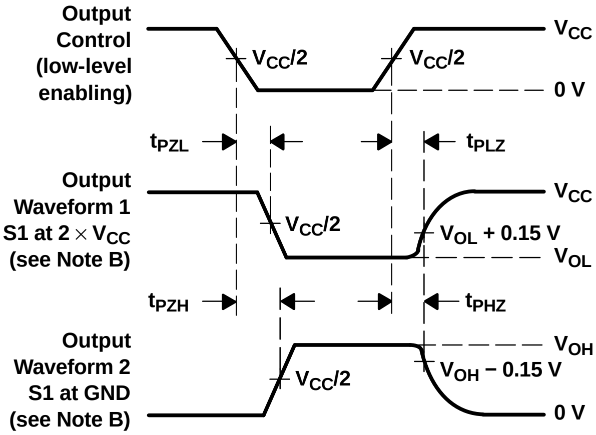
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 × V_{CC}
t_{PHZ}/t_{PZH}	GND



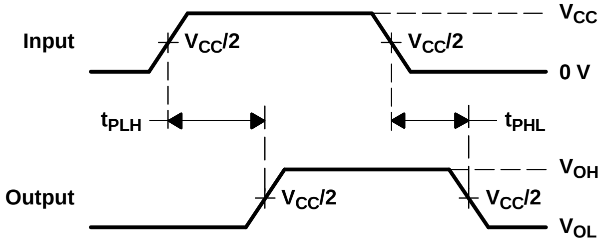
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

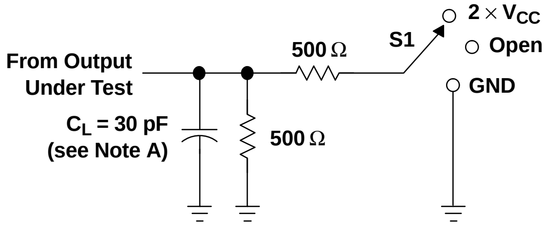


VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2 ns, t_f ≤ 2 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}.

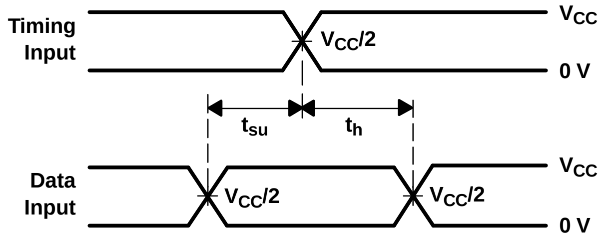
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 2.5 V ± 0.2 V



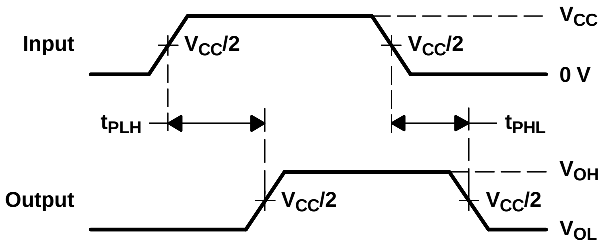
LOAD CIRCUIT

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

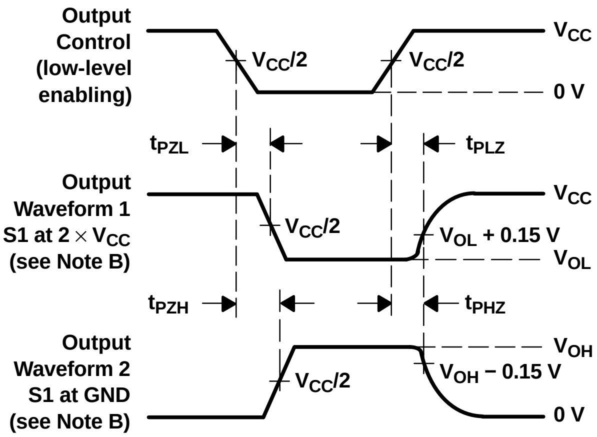


VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES

VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

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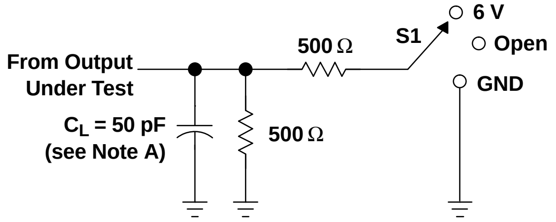
- D. The outputs are measured one at a time, with one transition per measurement.
- E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
- F. t_{PZL} and t_{PZH} are the same as t_{en}.
- G. t_{PLH} and t_{PHL} are the same as t_{pd}.

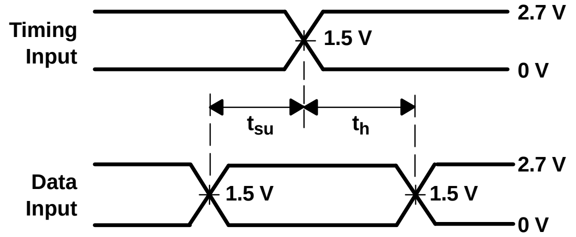
Figure 2. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 2.7 V AND 3.3 V ± 0.3 V

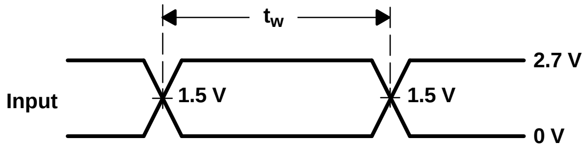


LOAD CIRCUIT

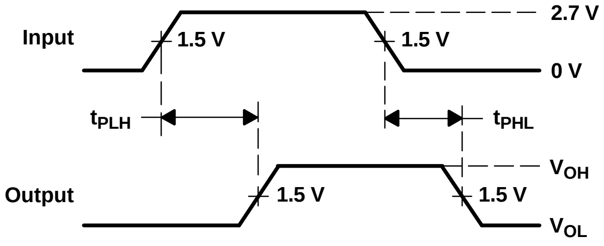
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



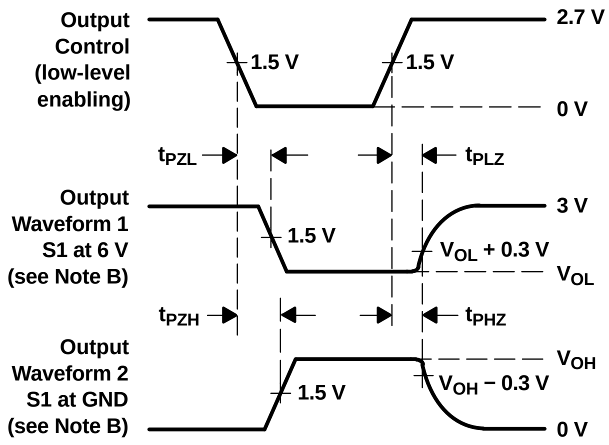
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES:
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- 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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 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}.

Figure 3. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
74ALVCH16271DGGRE4	ACTIVE	TSSOP	DGG	56	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVCH16271	Samples
SN74ALVCH16271DGGR	ACTIVE	TSSOP	DGG	56	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVCH16271	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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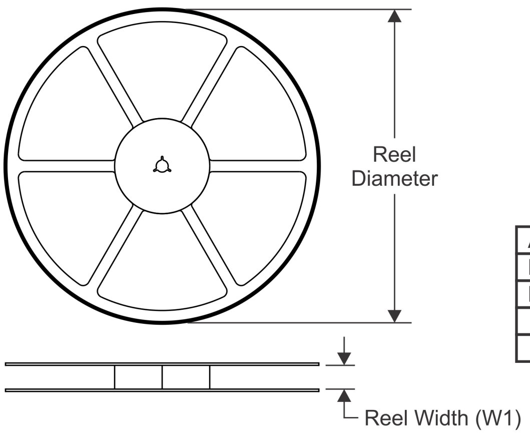
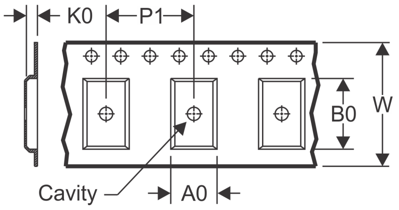
TAPE AND REEL INFORMATION

REEL DIMENSIONS

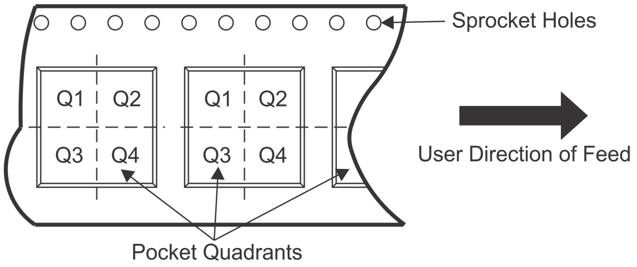


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

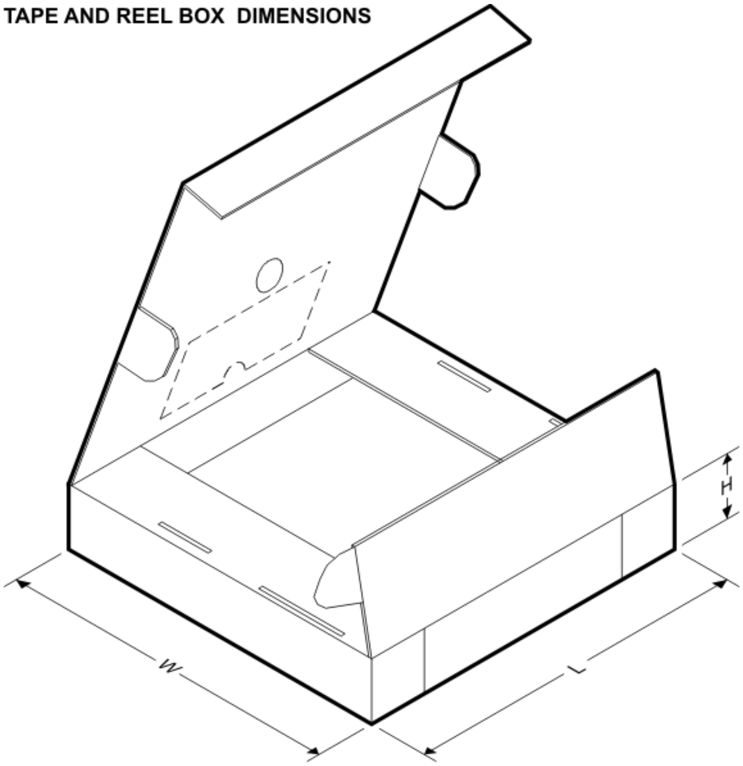
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

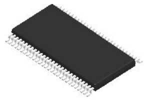
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74ALVCH16271DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVCH16271DGGR	TSSOP	DGG	56	2000	367.0	367.0	45.0

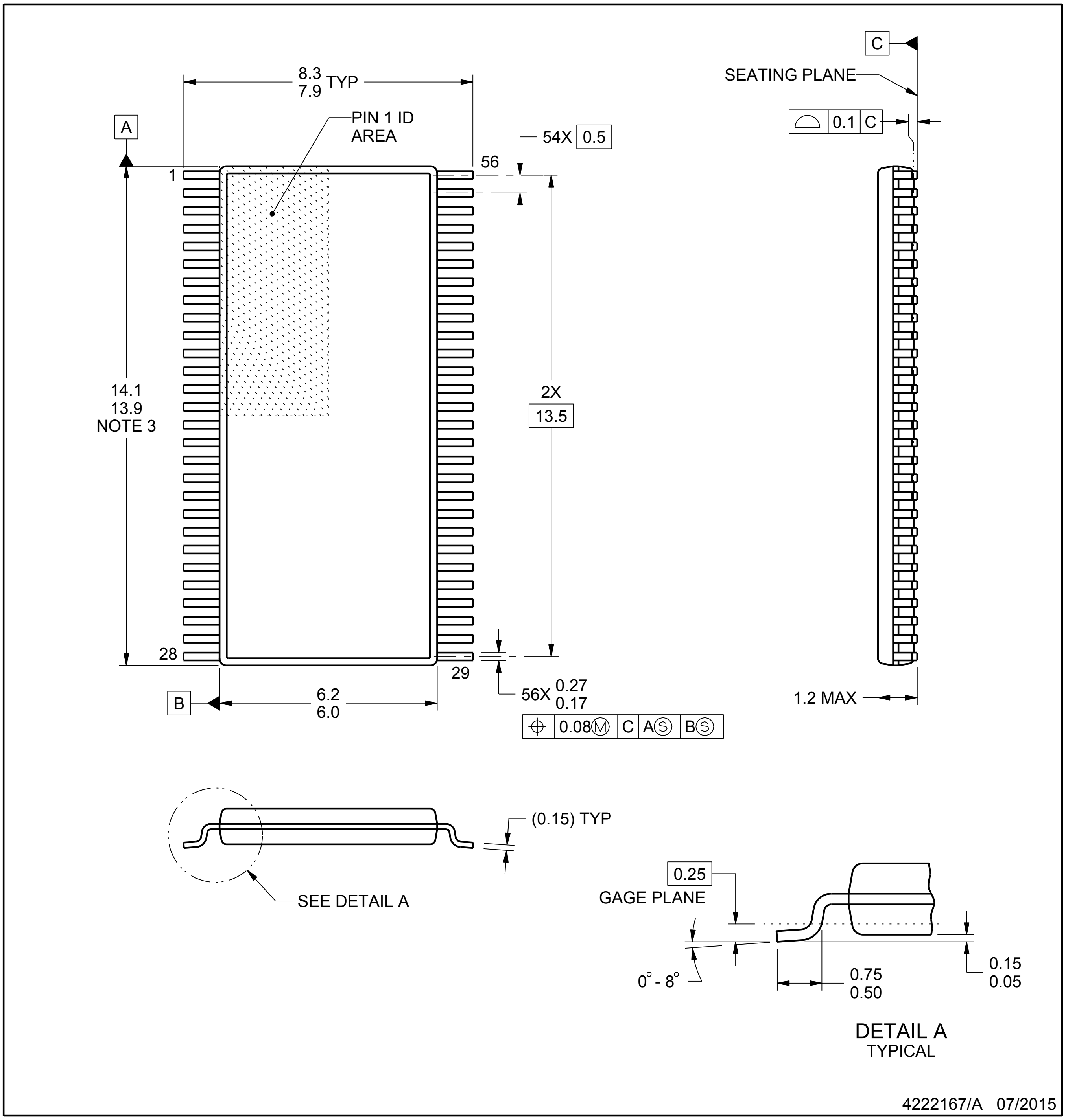


PACKAGE OUTLINE

DGG0056A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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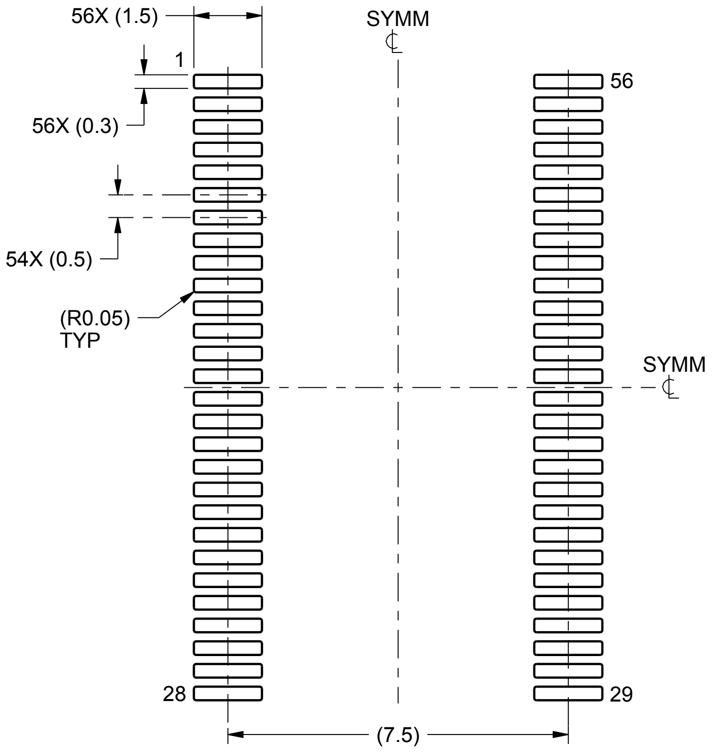
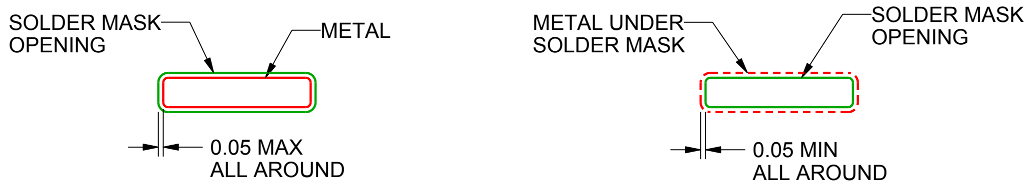
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.



LAND PATTERN EXAMPLE
SCALE:6X



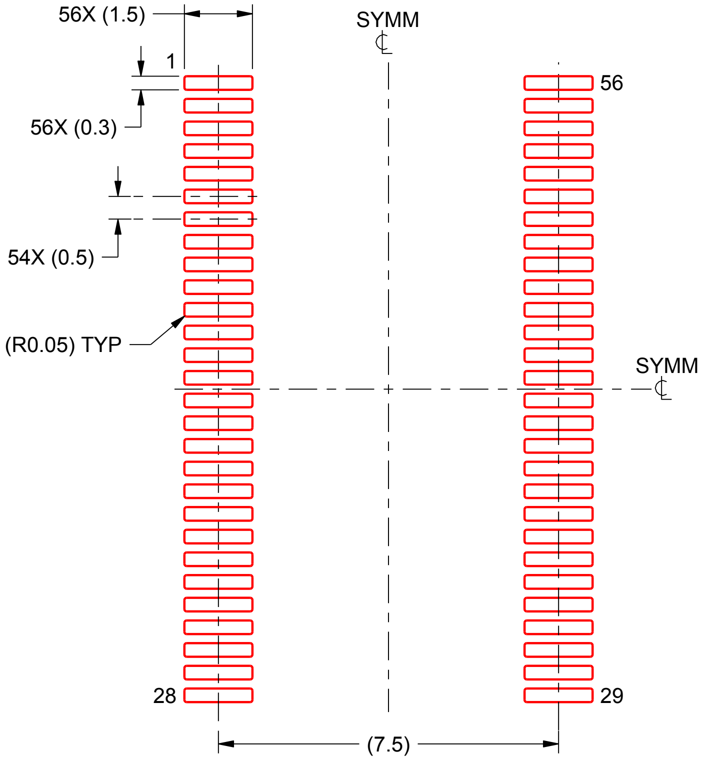
NON SOLDER MASK DEFINED

SOLDER MASK DEFINED

SOLDER MASK DETAILS

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

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NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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