SN74ALVCHG162280
16-BIT TO 32-BIT REGISTERED BUS EXCHANGER WITH BYTE MASKS AND 3-STATE OUTPUTS

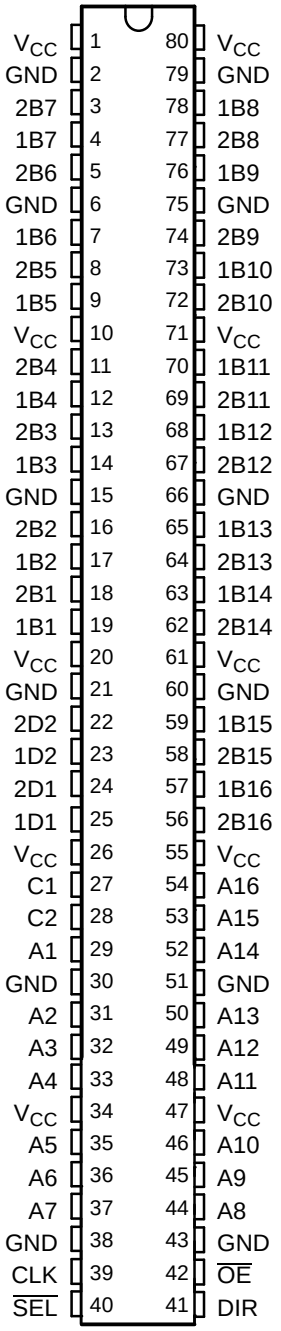
SCES093D–FEBRUARY 1997–REVISED OCTOBER 2004

FEATURES

- **Member of the Texas Instruments Widebus™ Family**
- **EPIC™ (Enhanced-Performance Implanted CMOS) Sub-Micron Process**
- **A-Port Outputs Have Equivalent 50-Ω Series Resistors and B-Port Outputs Have Equivalent 20-Ω Series Resistors, So No External Resistors Are Required**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Packaged in Thin Very Small-Outline Package**

NOTE: For order entry, the DBB package is abbreviated to G. For tape and reel, the DBBR package is abbreviated to GR.

DBB PACKAGE
(TOP VIEW)



DESCRIPTION

The SN74ALVCHG162280 is a 16-bit to 32-bit registered bus exchanger. This device is intended for use in applications where data must be transferred from a narrow high-speed bus to a wide lower-frequency bus. It is designed specifically for low-voltage (3.3-V) V_{CC} operation.

The device provides synchronous data exchange between the two ports, A and B. Data is stored in the internal registers on the low-to-high transition of the clock (CLK) input. For data transfer in the B-to-A direction, the select ($\overline{SEL}$) input selects 1B or 2B data for the A outputs.

For data transfer in the A-to-B direction, a two-stage pipeline is provided in the 1B path, with a single storage register in the 2B path. Data flow is controlled by the active-low output-enable ($\overline{OE}$) and direction-control (DIR) inputs. DIR is registered to synchronize the bus direction changes with the clock.

Two mask bits are provided for both data bytes. The data (D) outputs are controlled by $\overline{OE}$.

DESCRIPTION (CONTINUED)

The A-port N-channel output transistors are sized at 450 μm, and the P-channel output transistors are sized at 700 μm. All A-port outputs have equivalent 50-Ω series resistors. The B-port N-channel output transistors are sized at 225 μm, and the P-channel output transistors are sized at 560 μm. All B-port outputs have equivalent 20-Ω series resistors.

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 is provided to hold unused or floating data inputs at a valid logic level.

The switching characteristics are based on 25-pF (A port) and 80-pF (B and D ports) loads, but are tested with the standard 50-pF load.

The SN74ALVCHG162280 is characterized for operation from 0°C to 70°C.

FUNCTION TABLES

A-TO-B STORAGE ($\overline{OE}$ = L, DIR = H)

INPUTS			OUTPUTS	
$\overline{SEL}$	CLK	A	1B	2B
H	X	X	$1B_0$ (1)	$2B_0$ (1)
L	↑	L	L (2)	L
L	↑	H	H (2)	H

(1) Output level before indicated steady-state input conditions were established
(2) Two CLK edges are needed to propagate the data.

B-TO-A STORAGE ($\overline{OE}$ = L, DIR = L)

INPUTS				OUTPUT
CLK	$\overline{SEL}$	1B	2B	A
↑	H	X	L	L (1)
↑	H	X	H	H (1)
↑	L	L	X	L
↑	L	H	X	H

(1) Two CLK edges are needed to propagate the data. The data is loaded in the first register when $\overline{SEL}$ is low and propagates to the second register when $\overline{SEL}$ is high.

C-TO-D STORAGE ($\overline{OE}$ = L)

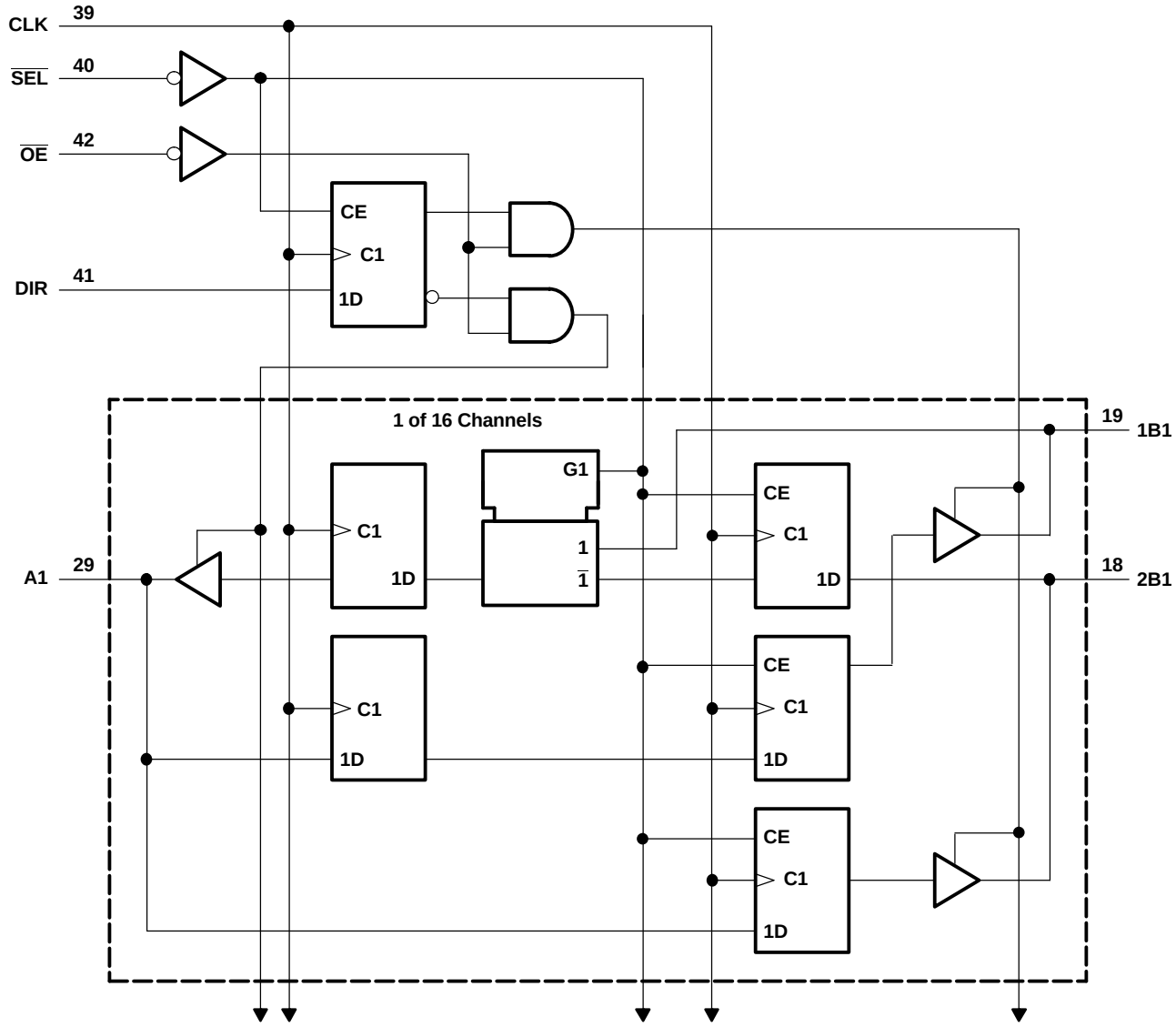
INPUTS			OUTPUTS	
$\overline{SEL}$	CLK	C	1D	2D
H	X	X	$1D_0$ (1)	$2D_0$ (1)
L	↑	L	L (2)	L
L	↑	H	H (2)	H

(1) Output level before indicated steady-state input conditions were established
(2) Two CLK edges are needed to propagate the data.

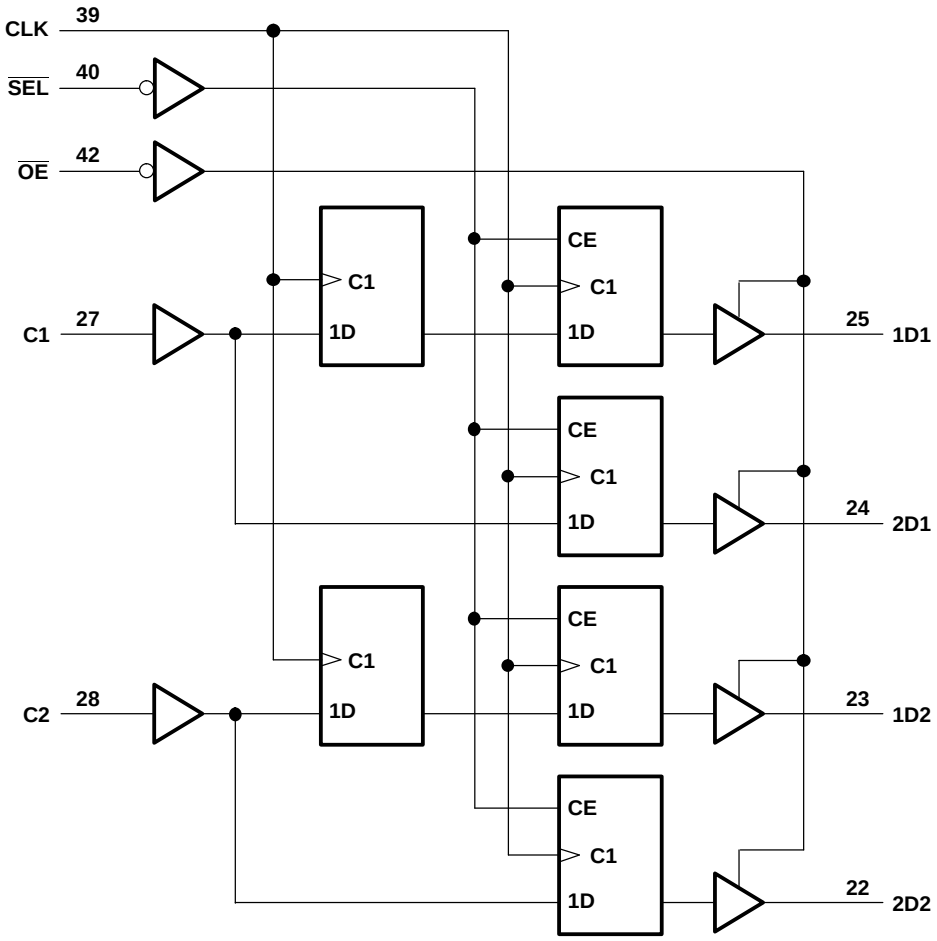
OUTPUT ENABLE

INPUTS			OUTPUTS		
CLK	$\overline{OE}$	DIR	A	1B, 2B	1D, 2D
↑	H	X	Z	Z	Z
↑	L	H	Z	Active	Active
↑	L	L	Active	Z	Active

LOGIC DIAGRAM, A AND B PORTS (POSITIVE LOGIC)



LOGIC DIAGRAM, C AND D PORTS (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	V_{CC} + 0.5	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_{OK}	Output clamp current	V_O < 0		-50	mA
I_O	Continuous output current			±50	mA
θ_{JA}	Package thermal impedance(4)			106	°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 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.

RECOMMENDED OPERATING CONDITIONS[1]

				MIN	MAX	UNIT
V_{CC}	Supply voltage			3	3.6	V
V_{IH}	High-level input voltage		V_{CC} = 3 V to 3.6 V	2		V
V_{IL}	Low-level input voltage		V_{CC} = 3 V to 3.6 V		0.8	V
V_I	Input voltage			0	V_{CC}	V
V_O	Output voltage			0	V_{CC}	V
I_{OH}	High-level output current	A to B	V_{CC} = 3 V		8	mA
		B to A	V_{CC} = 3 V		6	
I_{OL}	Low-level output current	A to B	V_{CC} = 3 V		8	mA
		B to A	V_{CC} = 3 V		6	
$\Delta t/\Delta v$	Input transition rise or fall rate				10	ns/V
T_A	Operating free-air temperature			0	70	°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	3 V to 3.6 V	V_{CC} - 0.2			V
	A to B	I_{OH} = -8 mA	3 V	2			
	B to A	I_{OH} = -6 mA	3 V	2			
V_{OL}		I_{OL} = 100 μA	3 V to 3.6 V			0.2	V
	A to B	I_{OL} = 8 mA	3 V			0.8	
	B to A	I_{OL} = 6 mA	3 V			0.8	
I_I		V_I = V_{CC} or GND	3.6 V			±5	μA
$I_{I(hold)}$		V_I = 0.8 V	3 V	75			μA
		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		4		pF
	C port				8.5		
C_o	D port	V_O = V_{CC} or GND	3.3 V		7		pF
C_{io}	A or B ports	V_O = V_{CC} or GND	3.3 V		8.5		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)

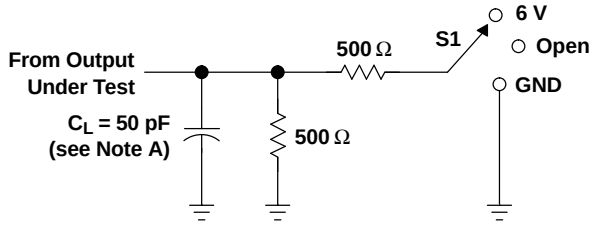
			V_{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	
f_{clock}	Clock frequency			160	MHz
t_w	Pulse duration, CLK high or low		2.3		ns
t_{su}	Setup time, high or low	A data before CLK↑	1.4		ns
		B data before CLK↑	2		
		C data before CLK↑	1.3		
		DIR before CLK↑	2		
		$\overline{SEL}$ before CLK↑	2		
t_h	Hold time, high or low	A data after CLK↑	0.3		ns
		B data after CLK↑	0.3		
		C data after CLK↑	0.3		
		DIR after CLK↑	0.3		
		$\overline{SEL}$ after CLK↑	0.3		

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, C_L = 25 pF (A port), 80 pF (B and D ports) (unless otherwise noted) (see Figure 1)

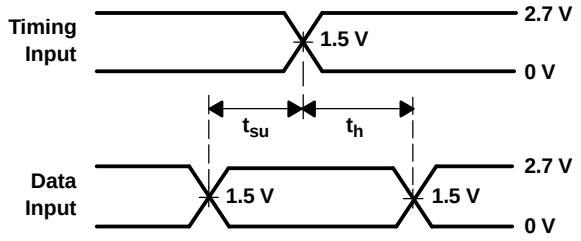
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	
f_{max}			160		MHz
t_{pd}	CLK	A	1.5	5	ns
		B	1.5	7.4	
		D	1.5	7.2	
t_{en}	CLK	A	1.5	6.2	ns
		B	1.5	9.4	
	$\overline{OE}$	A	1.5	6	
		B	1.5	9.5	
		D	1.5	7.9	
t_{dis}	CLK	A	1.5	6.4	ns
		B	1.5	7.8	
	$\overline{OE}$	A	1.5	5	
		B	1.5	7.6	
		D	1.5	6.7	

PARAMETER MEASUREMENT INFORMATION

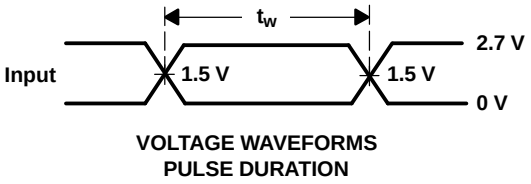


LOAD CIRCUIT

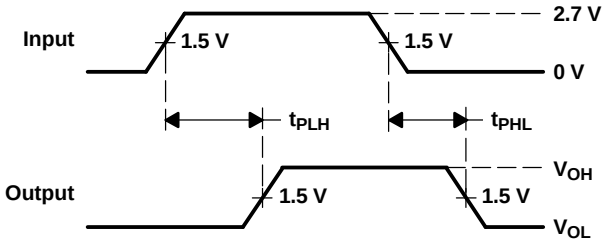
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



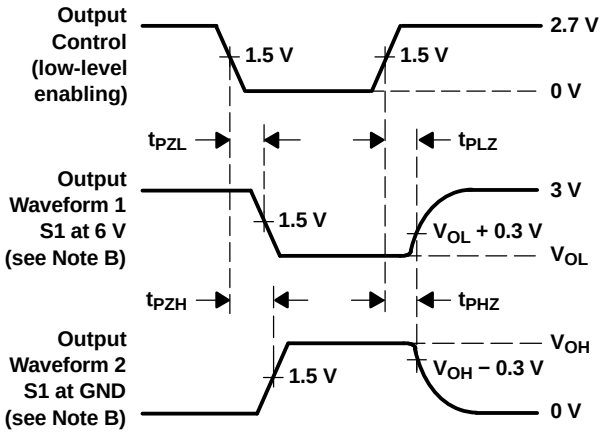
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES: 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 ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The output is measured with one input 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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
74ALVCHG162280GRE4	ACTIVE	TSSOP	DBB	80	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ALVCHG162280GRG4	ACTIVE	TSSOP	DBB	80	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALVCHG162280DBBR	OBSOLETE	TSSOP	DBB	80		TBD	Call TI	Call TI
SN74ALVCHG162280GR	ACTIVE	TSSOP	DBB	80	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

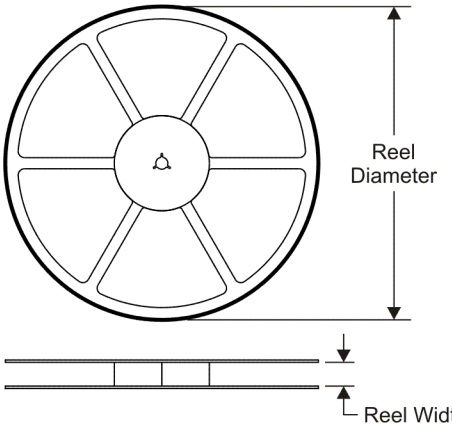
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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)

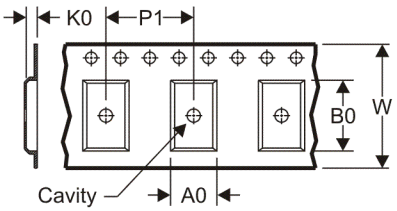
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

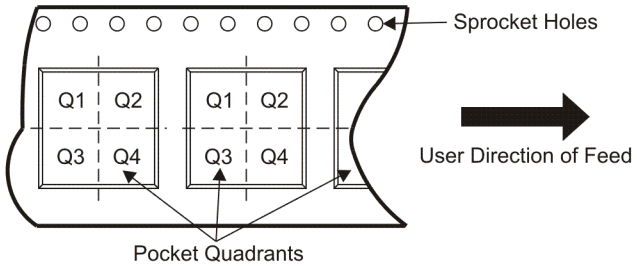


TAPE DIMENSIONS



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

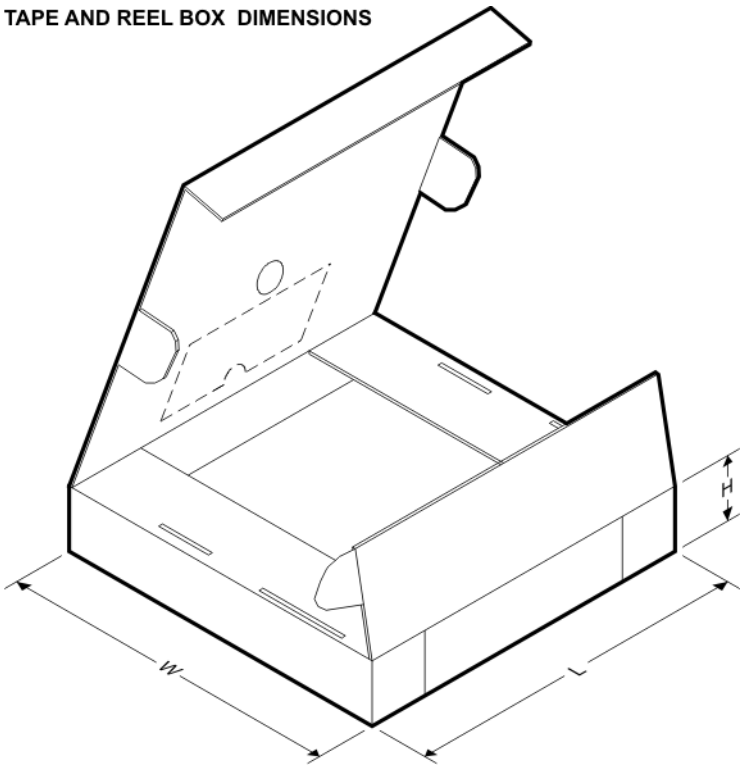
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74ALVCHG162280GR	TSSOP	DBB	80	2000	330.0	24.4	8.4	17.3	1.7	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

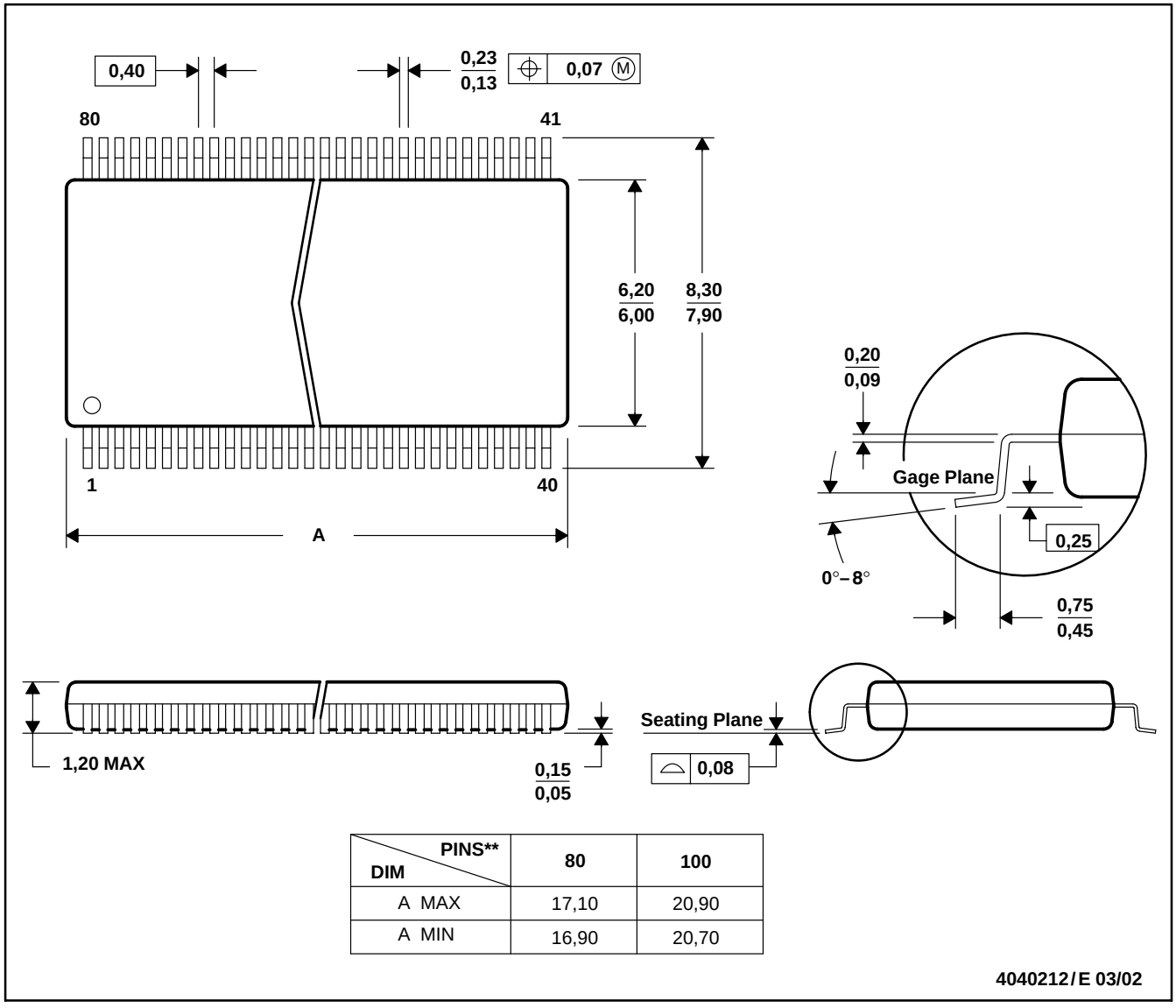


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVCHG162280GR	TSSOP	DBB	80	2000	346.0	346.0	41.0

DBB (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

80 PINS SHOWN



DIM \ PINS**	80	100
A MAX	17,10	20,90
A MIN	16,90	20,70

4040212/E 03/02

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Falls within JEDEC : 80 Pin – MO-153 Variation FF
100 Pin – MO-194 Variation BB

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Clocks and Timers	www.ti.com/clocks	Digital Control	www.ti.com/digitalcontrol
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265