

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.

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 ($\overline{\text{SEL}}$) 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 ($\overline{\text{OE}}$) 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 $\overline{\text{OE}}$.

DBB PACKAGE
(TOP VIEW)

V _{CC}	1	80	V _{CC}
GND	2	79	GND
2B7	3	78	1B8
1B7	4	77	2B8
2B6	5	76	1B9
GND	6	75	GND
1B6	7	74	2B9
2B5	8	73	1B10
1B5	9	72	2B10
V _{CC}	10	71	V _{CC}
2B4	11	70	1B11
1B4	12	69	2B11
2B3	13	68	1B12
1B3	14	67	2B12
GND	15	66	GND
2B2	16	65	1B13
1B2	17	64	2B13
2B1	18	63	1B14
1B1	19	62	2B14
V _{CC}	20	61	V _{CC}
GND	21	60	GND
2D2	22	59	1B15
1D2	23	58	2B15
2D1	24	57	1B16
1D1	25	56	2B16
V _{CC}	26	55	V _{CC}
C1	27	54	A16
C2	28	53	A15
A1	29	52	A14
GND	30	51	GND
A2	31	50	A13
A3	32	49	A12
A4	33	48	A11
V _{CC}	34	47	V _{CC}
A5	35	46	A10
A6	36	45	A9
A7	37	44	A8
GND	38	43	GND
CLK	39	42	$\overline{\text{OE}}$
$\overline{\text{SEL}}$	40	41	DIR



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

SCES093D—FEBRUARY 1997—REVISED OCTOBER 2004

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, $\overline{\text{OE}}$ 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.

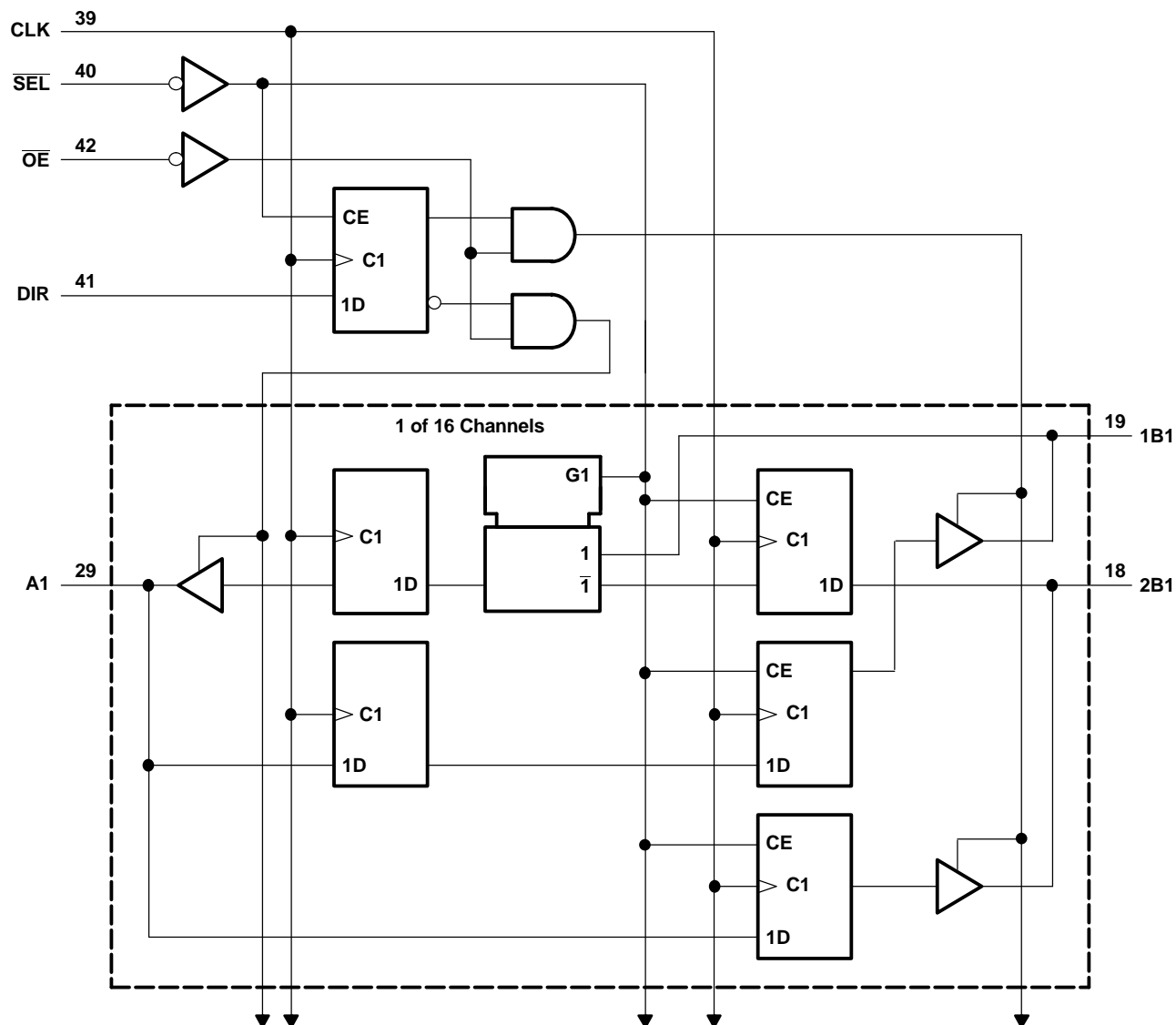
OUTPUT ENABLE

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

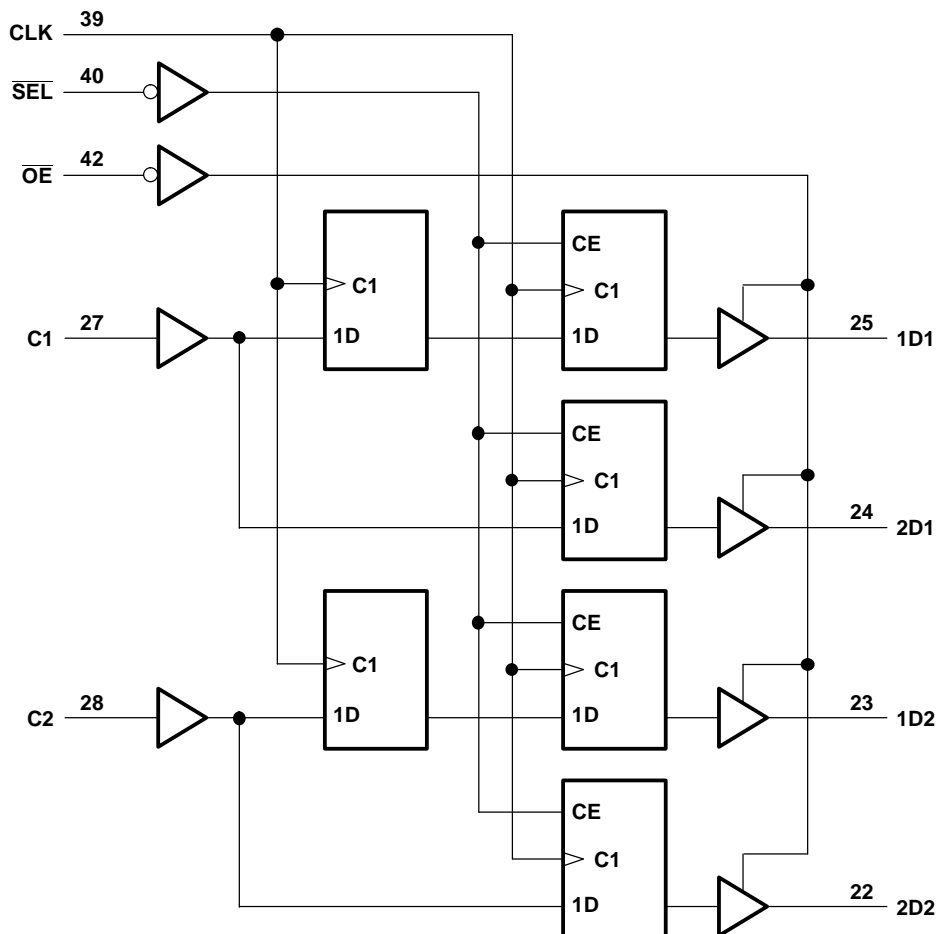
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LOGIC DIAGRAM, A AND B PORTS (POSITIVE LOGIC)



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	-0.5	$V_{CC} + 0.5$	V
		-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		-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.

SN74ALVCHG162280

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

SCES093D—FEBRUARY 1997—REVISED OCTOBER 2004

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

			MIN	MAX	UNIT
V_{CC}	Supply voltage		3	3.6	V
V_{IH}	High-level input voltage	$V_{CC} = 3\text{ V to }3.6\text{ V}$	2		V
V_{IL}	Low-level input voltage	$V_{CC} = 3\text{ V to }3.6\text{ V}$		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		8	mA
		B to A		6	
I_{OL}	Low-level output current	A to B		8	mA
		B to A		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 $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

(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)

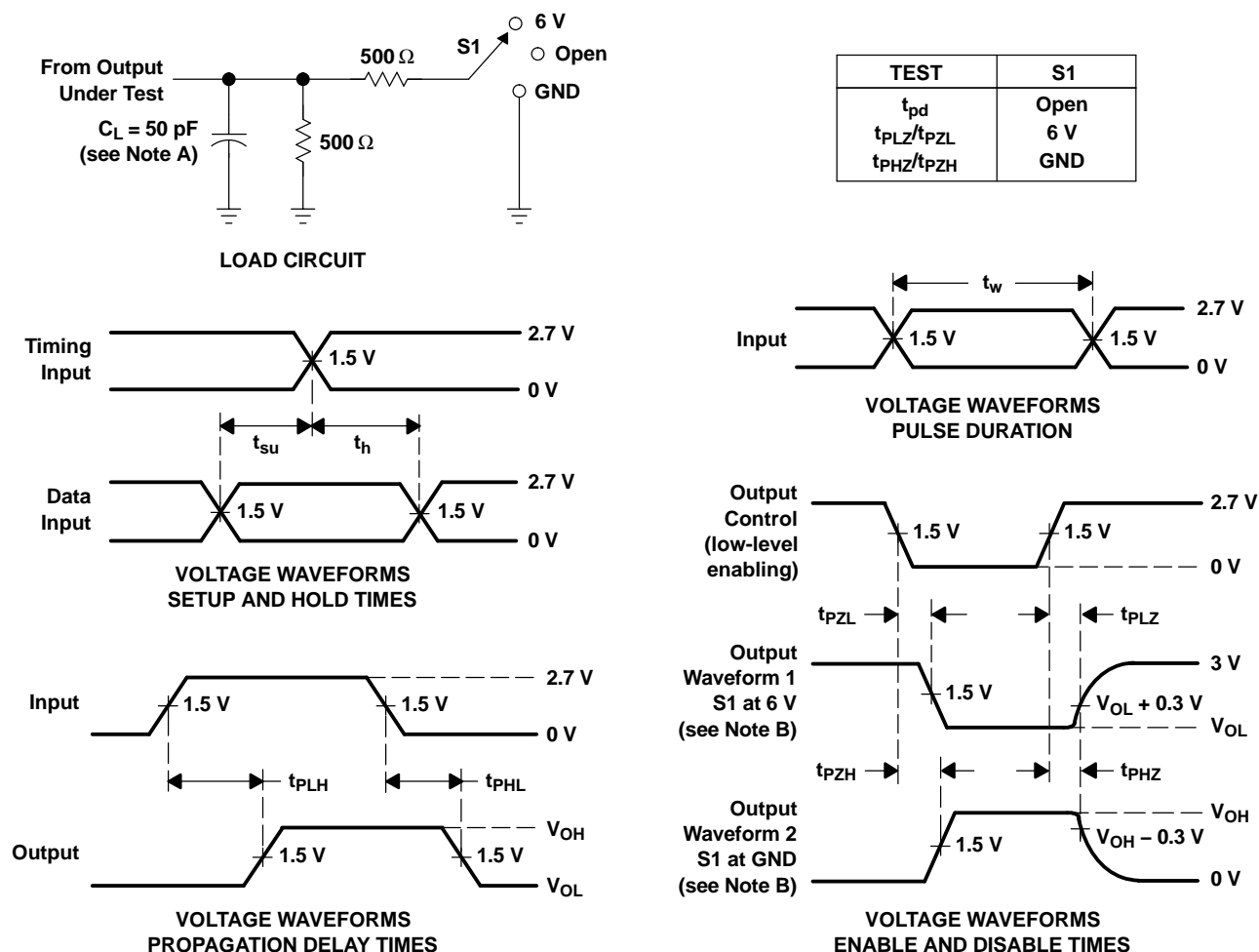
			$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT
			MIN	MAX	
f_{clock}	Clock frequency			160	MHz
t_w	Pulse duration, CLK high or low		2.3		ns
t_{su}	Setup time, high or low	A data before CLK \uparrow	1.4		ns
		B data before CLK \uparrow	2		
		C data before CLK \uparrow	1.3		
		DIR before CLK \uparrow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

SWITCHING CHARACTERISTICS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		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	
	$\overline{\text{OE}}$	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	
	$\overline{\text{OE}}$	A	1.5	5	
		B	1.5	7.6	
		D	1.5	6.7	

PARAMETER MEASUREMENT INFORMATION



- 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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 - The output is measured with one input 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} .

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.

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TAPE AND REEL INFORMATION



*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



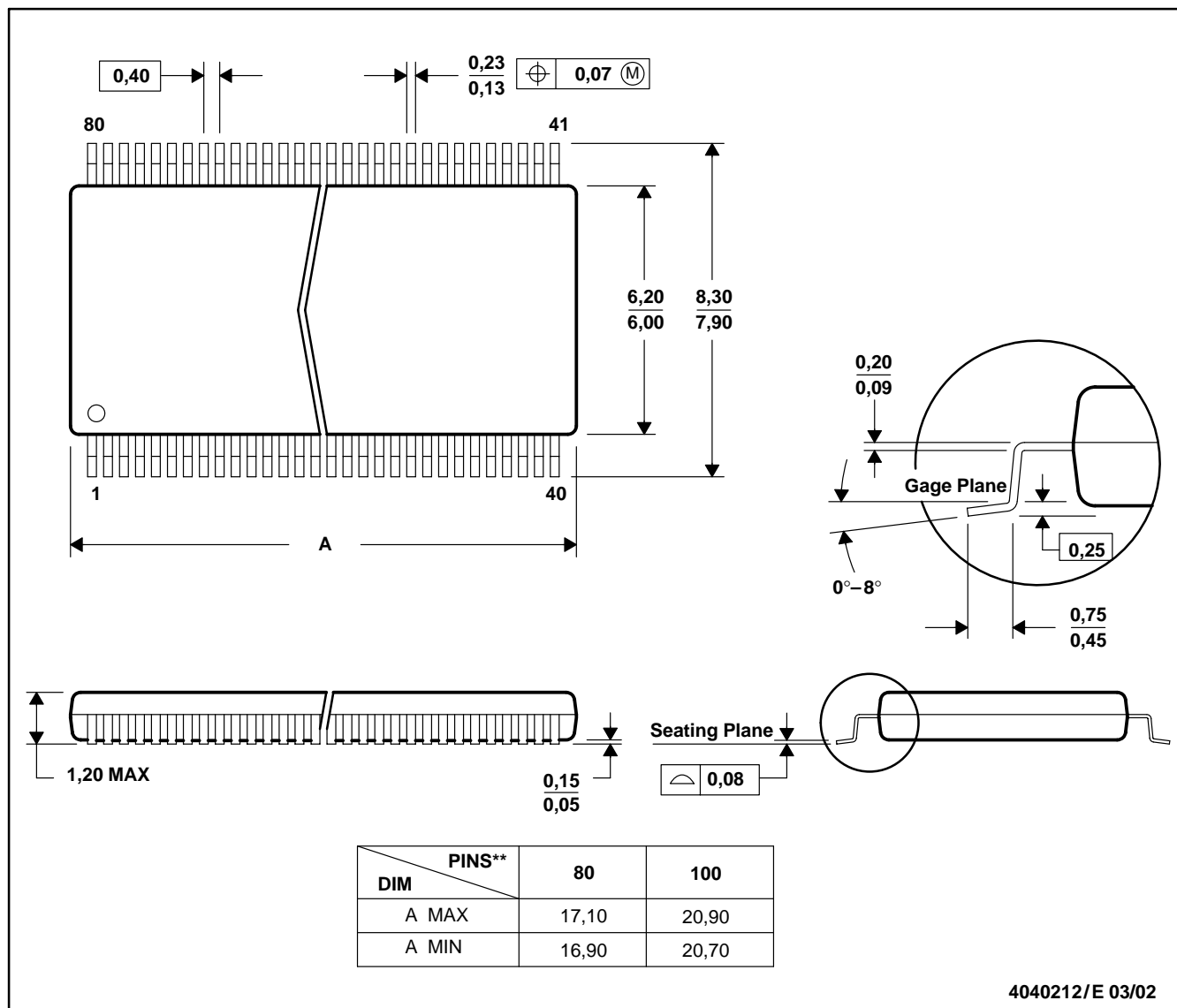
*All dimensions are nominal

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



- 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

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