



**THE DATASHEET OF  
SN74ALVCHG162280GR**



## 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

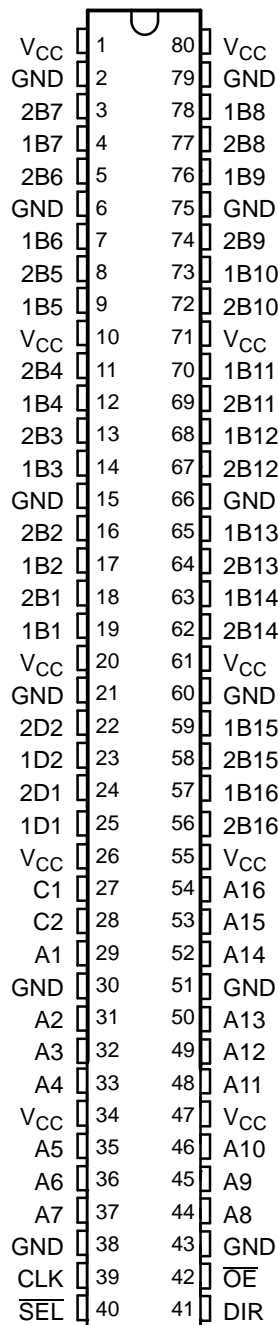
The SN74ALVCHG162280 is a 16-bit to 32-bit registered bus exchanger. This device is intended for use in applications where data must be transferred from a narrow high-speed bus to a wide lower-frequency bus. It is designed specifically for low-voltage (3.3-V)  $V_{CC}$  operation.

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

DBB PACKAGE  
(TOP VIEW)



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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

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### DESCRIPTION (CONTINUED)

The A-port N-channel output transistors are sized at 450  $\mu\text{m}$ , and the P-channel output transistors are sized at 700  $\mu\text{m}$ . All A-port outputs have equivalent 50- $\Omega$  series resistors. The B-port N-channel output transistors are sized at 225  $\mu\text{m}$ , and the P-channel output transistors are sized at 560  $\mu\text{m}$ . All B-port outputs have equivalent 20- $\Omega$  series resistors.

To ensure the high-impedance state during power up or power down,  $\overline{\text{OE}}$  should be tied to  $V_{\text{CC}}$  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 <sub>0</sub> <sup>(1)</sup>	2B <sub>0</sub> <sup>(1)</sup>
L	↑	L	L <sup>(2)</sup>	L
L	↑	H	H <sup>(2)</sup>	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 <sup>(1)</sup>
↑	H	X	H	H <sup>(1)</sup>
↑	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 <sub>0</sub> <sup>(1)</sup>	2D <sub>0</sub> <sup>(1)</sup>
L	↑	L	L <sup>(2)</sup>	L
L	↑	H	H <sup>(2)</sup>	H

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

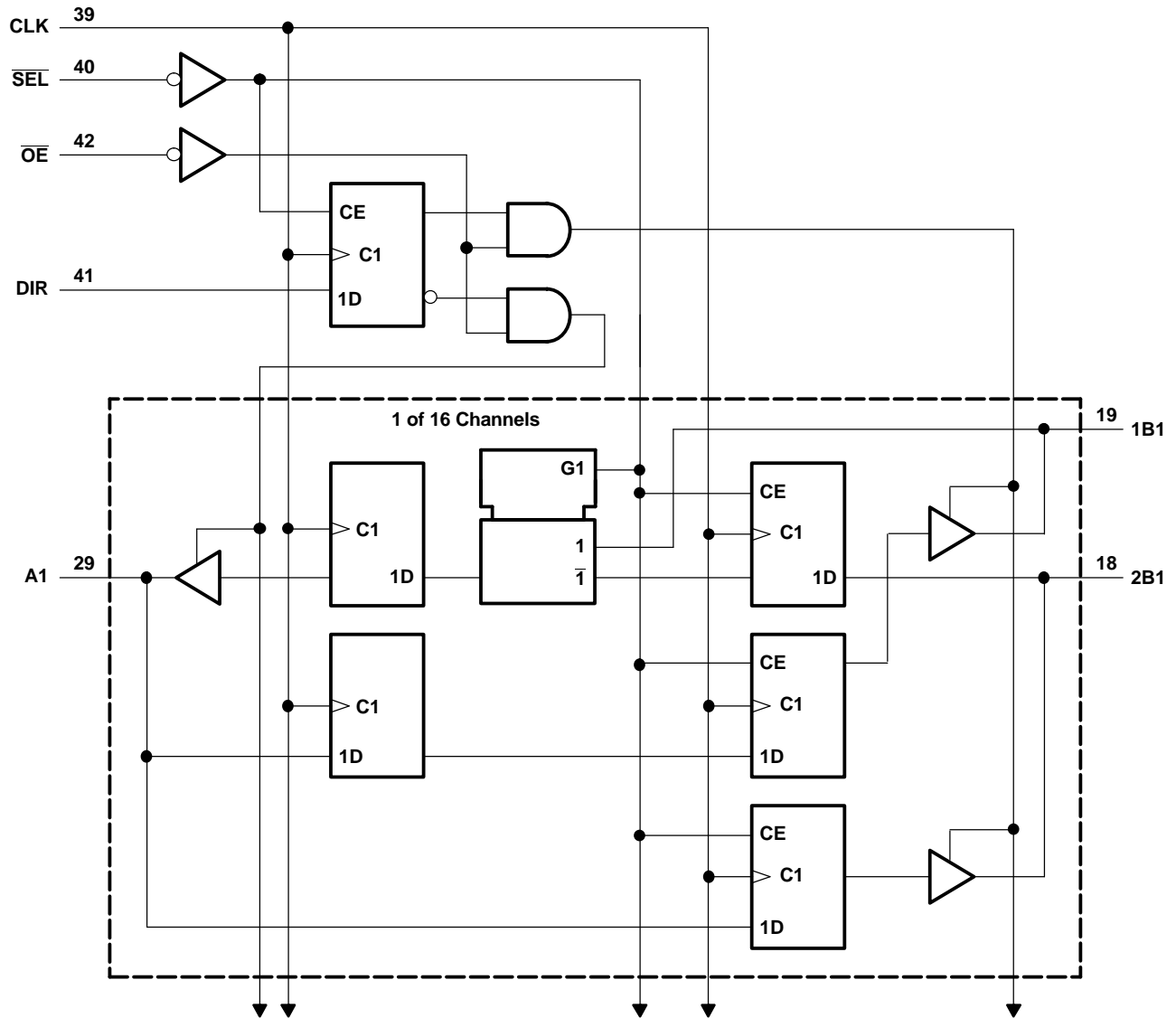
**OUTPUT ENABLE**

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

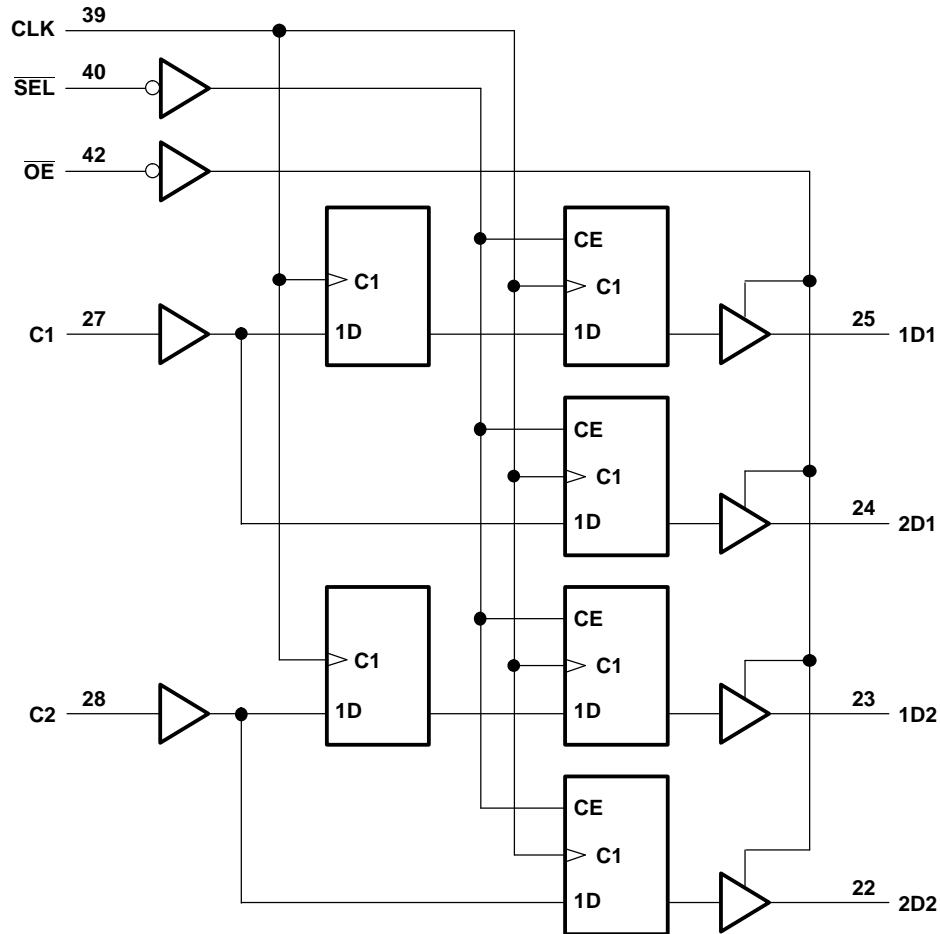
**SN74ALVCHG162280**  
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**LOGIC DIAGRAM, A AND B PORTS (POSITIVE LOGIC)**



**LOGIC DIAGRAM, C AND D PORTS (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	Except I/O ports <sup>(2)</sup>	-0.5	$V_{CC} + 0.5$
		I/O ports <sup>(2)(3)</sup>	-0.5	$V_{CC} + 0.5$
$V_O$	Output voltage range <sup>(2)(3)</sup>	-0.5	$V_{CC} + 0.5$	V
$I_{OK}$	Output clamp current		-50	mA
$I_O$	Continuous output current		$\pm 50$	mA
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>		106	$^{\circ}\text{C}/\text{W}$
$T_{stg}$	Storage temperature range	-65	150	$^{\circ}\text{C}$

- (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.

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**RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>**

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage		3	3.6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 3 V to 3.6 V	2		V
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 3 V to 3.6 V		0.8	V
V <sub>I</sub>	Input voltage		0	V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage		0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current	A to B	V <sub>CC</sub> = 3 V		8
		B to A	V <sub>CC</sub> = 3 V		
I <sub>OL</sub>	Low-level output current	A to B	V <sub>CC</sub> = 3 V		8
		B to A	V <sub>CC</sub> = 3 V		
Δt/Δv	Input transition rise or fall rate			10	ns/V
T <sub>A</sub>	Operating free-air temperature		0	70	°C

(1) All unused control inputs of the device must be held at V<sub>CC</sub> 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 <sub>CC</sub>	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>OH</sub>		I <sub>OH</sub> = -100 μA	3 V to 3.6 V	V <sub>CC</sub> - 0.2		V	
	A to B	I <sub>OH</sub> = -8 mA	3 V	2			
	B to A	I <sub>OH</sub> = -6 mA	3 V	2			
V <sub>OL</sub>		I <sub>OL</sub> = 100 μA	3 V to 3.6 V	0.2		V	
	A to B	I <sub>OL</sub> = 8 mA	3 V	0.8			
	B to A	I <sub>OL</sub> = 6 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>I(hold)</sub>		V <sub>I</sub> = 0.8 V	3 V	75		μA	
		V <sub>I</sub> = 2 V	3 V	-75			
		V <sub>I</sub> = 0 to 3.6 V <sup>(2)</sup>	3.6 V	±500			
I <sub>OZ</sub> <sup>(3)</sup>		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	3.3 V	4		pF	
	C port			8.5			
C <sub>O</sub>	D port	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V	7		pF	
C <sub>iO</sub>	A or B ports	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V	8.5		pF	

(1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 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<sub>OZ</sub> includes the input leakage current.

## TIMING REQUIREMENTS

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

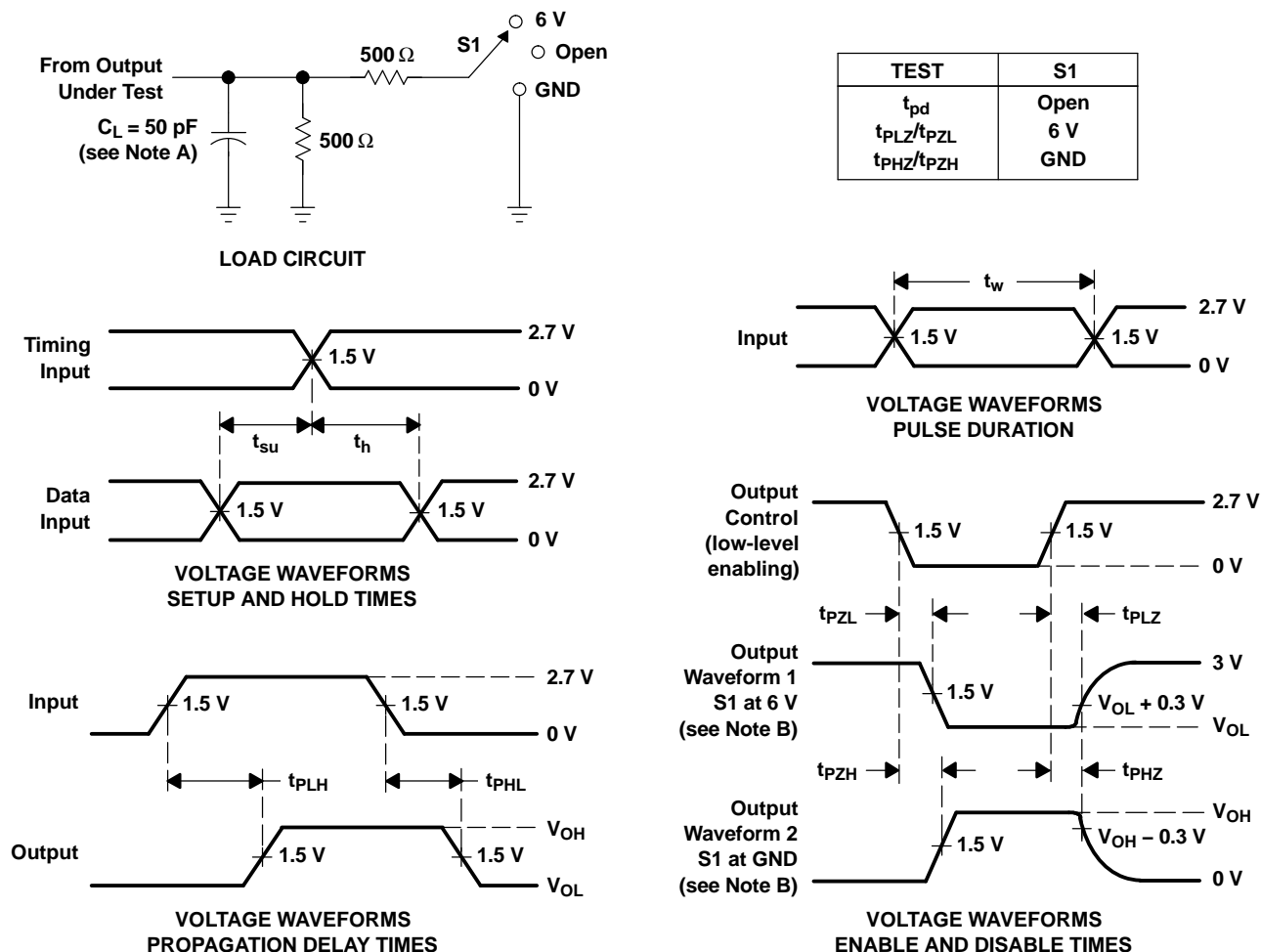
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
		MIN	MAX	
$f_{\text{clock}}$	Clock frequency	160		MHz
$t_w$	Pulse duration, CLK high or low	2.3		ns
$t_{\text{su}}$	Setup time, high or low	A data before CLK $\uparrow$	1.4	ns
		B data before CLK $\uparrow$	2	
		C data before CLK $\uparrow$	1.3	
		DIR before 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),  $80\text{ pF}$  (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	
$f_{\text{max}}$			160		MHz
$t_{\text{pd}}$	CLK	A	1.5	5	ns
		B	1.5	7.4	
		D	1.5	7.2	
$t_{\text{en}}$	CLK	A	1.5	6.2	ns
		B	1.5	9.4	
		D	1.5	7.9	
	$\overline{\text{OE}}$	A	1.5	6	
		B	1.5	9.5	
		D	1.5	7.9	
$t_{\text{dis}}$	CLK	A	1.5	6.4	ns
		B	1.5	7.8	
		D	1.5	6.7	
	$\overline{\text{OE}}$	A	1.5	5	
		B	1.5	7.6	
		D	1.5	6.7	

PARAMETER MEASUREMENT INFORMATION



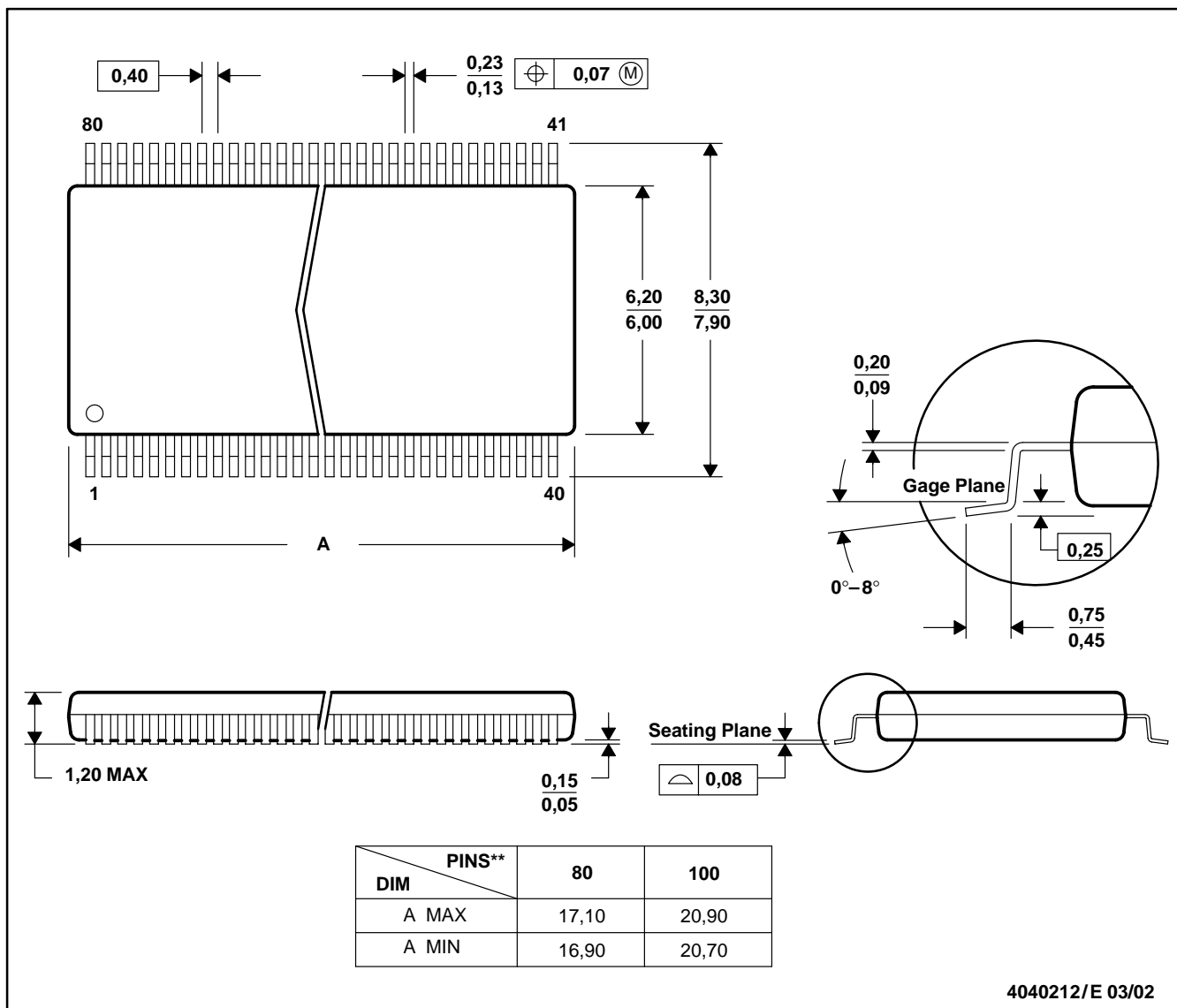
- NOTES:
- A.  $C_L$  includes probe and jig capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
  - C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - 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

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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