

FEATURES

- Member of the Texas Instruments Widebus™ Family
- Operates From 1.65 V to 3.6 V
- Max t_{pd} of 4.8 ns at 3.3 V
- ± 24 -mA Output Drive at 3.3 V
- B-Port Outputs Have Equivalent 26- Ω Series Resistors, So No External Resistors Are Required
- 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)

DESCRIPTION/ORDERING INFORMATION

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

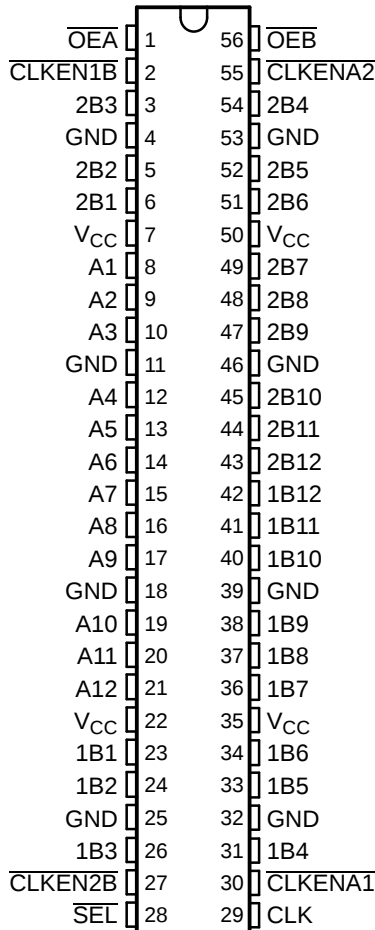
The SN74ALVCH162268 is used for applications in which data must be transferred from a narrow high-speed bus to a wide, lower-frequency bus.

The device provides synchronous data exchange between the two ports. Data is stored in the internal registers on the low-to-high transition of the clock (CLK) input when the appropriate clock-enable (CLKEN) inputs are low. The select (SEL) line is synchronous with CLK and selects 1B or 2B input data for the A outputs.

For data transfer in the A-to-B direction, a two-stage pipeline is provided in the A-to-1B path, with a single storage register in the A-to-2B path. Proper control of these inputs allows two sequential 12-bit words to be presented synchronously as a 24-bit word on the B port. Data flow is controlled by the active-low output enables ($\overline{OEA}$, $\overline{OEB}$). These control terminals are registered, so bus direction changes are synchronous with CLK.

The B outputs, which are designed to sink up to 12 mA, include equivalent 26- Ω resistors to reduce overshoot and undershoot.

DGG OR DL PACKAGE
(TOP VIEW)



ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP - DL	Tube	SN74ALVCH162268DL	ALVCH162268
		Tape and reel	SN74ALVCH162268DLR	
	TSSOP - DGG	Tape and reel	SN74ALVCH162268GR	ALVCH162268
	VFBGA - GQL	Tape and reel	SN74ALVCH162268KR	VH2268
	VFBGA - ZQL (Pb-free)		74ALVCH162268ZQLR	

(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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SN74ALVCH162268

12-BIT TO 24-BIT REGISTERED BUS EXCHANGER WITH 3-STATE OUTPUTS

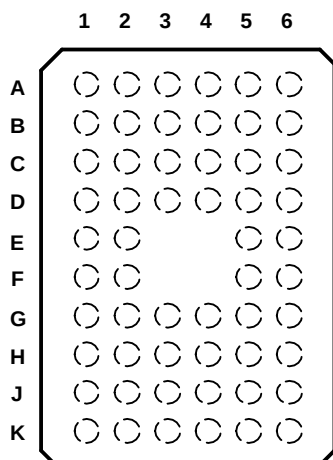
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DESCRIPTION/ORDERING INFORMATION (CONTINUED)

To ensure the high-impedance state during power up or power down, a clock pulse should be applied as soon as possible, and $\overline{OE}$ 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. Due to $\overline{OE}$ being routed through a register, the active state of the outputs cannot be determined prior to the arrival of the first clock pulse.

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.

**GQL OR ZQL PACKAGE
(TOP VIEW)**



TERMINAL ASSIGNMENTS

	1	2	3	4	5	6
A	2B3	$\overline{CLKEN1B}$	$\overline{OE_A}$	$\overline{OE_B}$	$\overline{CLKENA2}$	2B4
B	2B1	2B2	GND	GND	2B5	2B6
C	A2	A1	V_{CC}	V_{CC}	2B7	2B8
D	A4	A3	GND	GND	2B9	2B10
E	A6	A5			2B11	2B12
F	A7	A8			1B11	1B12
G	A9	A10	GND	GND	1B9	1B10
H	A11	A12	V_{CC}	V_{CC}	1B7	1B8
J	1B1	1B2	GND	GND	1B5	1B6
K	1B3	$\overline{CLKEN2B}$	$\overline{SEL}$	CLK	$\overline{CLKENA1}$	1B4

FUNCTION TABLES

OUTPUT ENABLE

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

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

INPUTS				OUTPUTS	
$\overline{CLKEN}A1$	$\overline{CLKEN}A2$	CLK	A	1B	2B
H	H	X	X	1B ₀ ⁽¹⁾	2B ₀ ⁽¹⁾
L	L	↑	L	L ⁽²⁾	X
L	L	↑	H	H ⁽²⁾	X
X	L	↑	L	X	L
X	L	↑	H	X	H

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

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

INPUTS						OUTPUT
$\overline{CLKEN}1B$	$\overline{CLKEN}2B$	CLK	$\overline{SEL}$	1B	2B	A
H	X	X	H	X	X	A ₀ ⁽¹⁾
X	H	X	L	X	X	A ₀ ⁽¹⁾
L	L	↑	H	L	X	L
L	L	↑	H	H	X	H
X	L	↑	L	X	L	L
X	L	↑	L	X	H	H

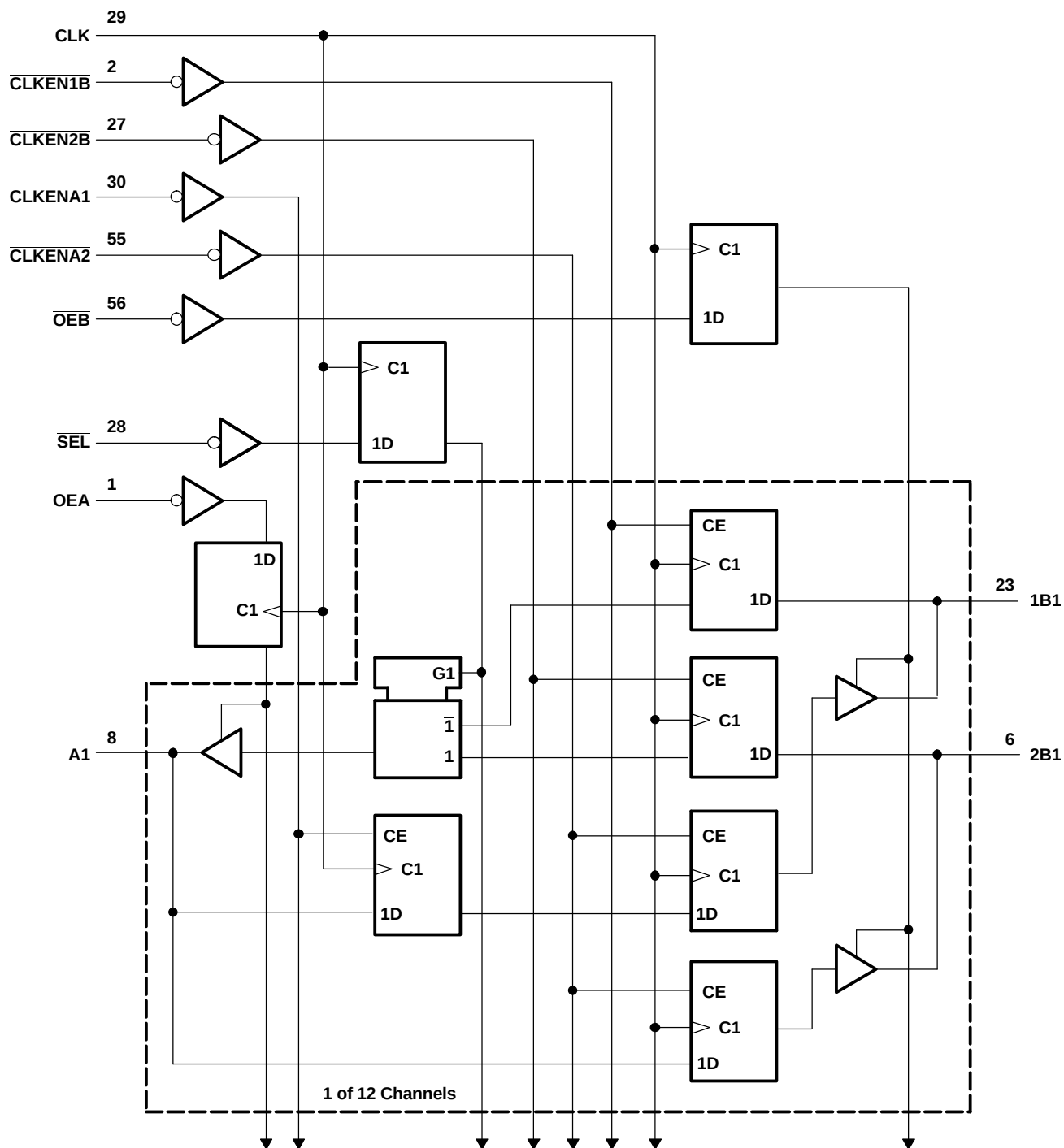
- (1) Output level before the indicated steady-state input conditions were established

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12-BIT TO 24-BIT REGISTERED BUS EXCHANGER WITH 3-STATE OUTPUTS

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LOGIC DIAGRAM (POSITIVE LOGIC)



Pin numbers shown are for the DGG and DL packages.

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	
		GQL/ZQL package		42	
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.

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12-BIT TO 24-BIT REGISTERED BUS EXCHANGER
WITH 3-STATE OUTPUTS

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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 (A port)	V _{CC} = 1.65 V	-4		mA
		V _{CC} = 2.3 V	-12		
		V _{CC} = 2.7 V	-12		
		V _{CC} = 3 V	-24		
	High-level output current (B port)	V _{CC} = 1.65 V	-2		
		V _{CC} = 2.3 V	-6		
		V _{CC} = 2.7 V	-8		
		V _{CC} = 3 V	-12		
I _{OL}	Low-level output current (A port)	V _{CC} = 1.65 V	4		mA
		V _{CC} = 2.3 V	12		
		V _{CC} = 2.7 V	12		
		V _{CC} = 3 V	24		
	Low-level output current (B port)	V _{CC} = 1.65 V	2		
		V _{CC} = 2.3 V	6		
		V _{CC} = 2.7 V	8		
		V _{CC} = 3 V	12		
Δt/Δv	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}	A port	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			
	B port	I _{OH} = -100 µA	1.65 V to 3.6 V	V _{CC} - 0.2			
		I _{OH} = -2 mA	1.65 V	1.2			
		I _{OH} = -4 mA	2.3 V	1.9			
		I _{OH} = -6 mA	2.3 V	1.7			
			3 V	2.4			
		I _{OH} = -8 mA	2.7 V	2			
		I _{OH} = -12 mA	3 V	2			
V _{OL}	A port	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	
	B port	I _{OL} = 100 µA	1.65 V to 3.6 V			0.2	
		I _{OL} = 2 mA	1.65 V			0.45	
		I _{OL} = 4 mA	2.3 V			0.4	
		I _{OL} = 6 mA	2.3 V			0.55	
			3 V			0.55	
		I _{OL} = 8 mA	2.7 V			0.6	
		I _{OL} = 12 mA	3 V			0.8	
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			-25		
		V _I = 0.7 V	2.3 V		45		
		V _I = 1.7 V			-45		
		V _I = 0.8 V	3 V		75		
		V _I = 2 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.

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12-BIT TO 24-BIT REGISTERED BUS EXCHANGER WITH 3-STATE OUTPUTS

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TIMING REQUIREMENTS

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

		$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT	
		MIN	MAX	MIN	MAX	MIN	MAX		
f_{clock}	Clock frequency		120		125		150		MHz
t_w	Pulse duration, CLK high or low		3.3		3.3		3.3		ns
t_{su}	Setup time	A data before CLK↑	4.5		4		3.4		ns
		B data before CLK↑	0.8		1.2		1		
		$\overline{\text{SEL}}$ before CLK↑	1.4		1.6		1.3		
		$\overline{\text{CLKENA1}}$ or $\overline{\text{CLKENA2}}$ before CLK↑	3.6		3.4		2.8		
		$\overline{\text{CLKEN1B}}$ or $\overline{\text{CLKEN2B}}$ before CLK↑	3.2		3		2.5		
		$\overline{\text{OE}}$ before CLK↑	4.2		3.9		3.2		
t_h	Hold time	A data after CLK↑	0		0		0.2		ns
		B data after CLK↑	1.3		1.2		1.3		
		$\overline{\text{SEL}}$ after CLK↑	1		1		1		
		$\overline{\text{CLKENA1}}$ or $\overline{\text{CLKENA2}}$ after CLK↑	0.1		0.1		0.4		
		$\overline{\text{CLKEN1B}}$ or $\overline{\text{CLKEN2B}}$ after CLK↑	0.1		0		0.5		
		$\overline{\text{OE}}$ after CLK↑	0		0		0.2		

SWITCHING CHARACTERISTICS

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

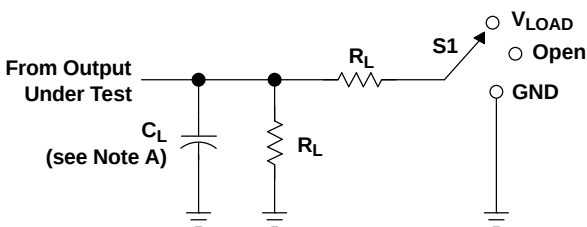
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}				120		125		150		MHz
t_{pd}	CLK	B	8	1.6	6.1	5.9		1.8	5.4	ns
		A (1B)	8	1.6	5.8	5.4		1.7	4.8	
		A (2B)	8	1.6	5.8	5.3		1.8	4.8	
		A ($\overline{\text{SEL}}$)	11	2.5	7.3	6.5		2.4	5.8	
t_{en}	CLK	B	12	2.7	7.2	6.8		2.6	6.1	ns
		A	9	2	6.2	5.6		1.8	5.1	
t_{dis}	CLK	B	10	2.8	7.2	6.1		2.5	5.9	ns
		A	9	2	6.5	5.4		2.1	5	

OPERATING CHARACTERISTICS

$T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
			TYP	TYP	
C_{pd}	Power dissipation capacitance	Outputs enabled	87	120	pF
		Outputs disabled	80.5	118	

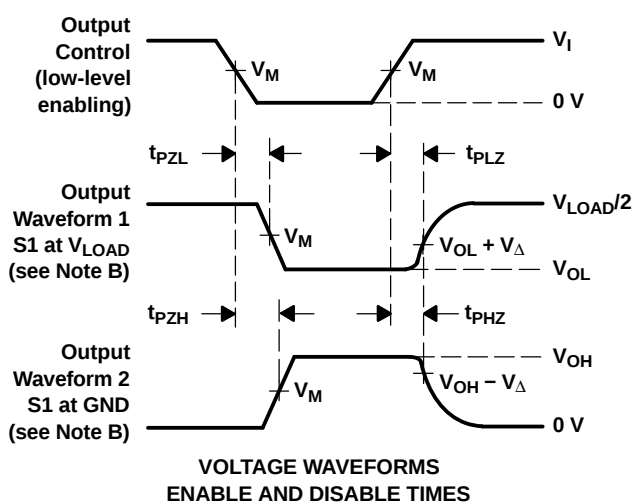
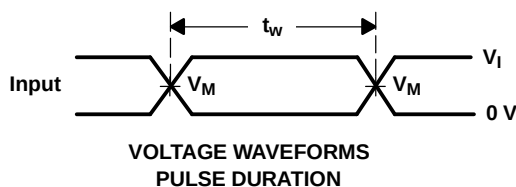
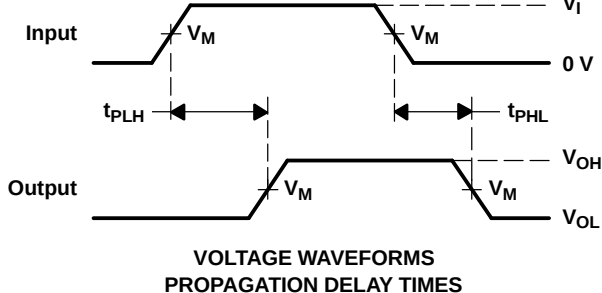
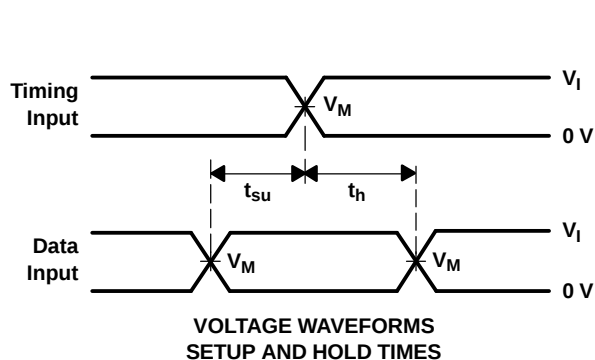
PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

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

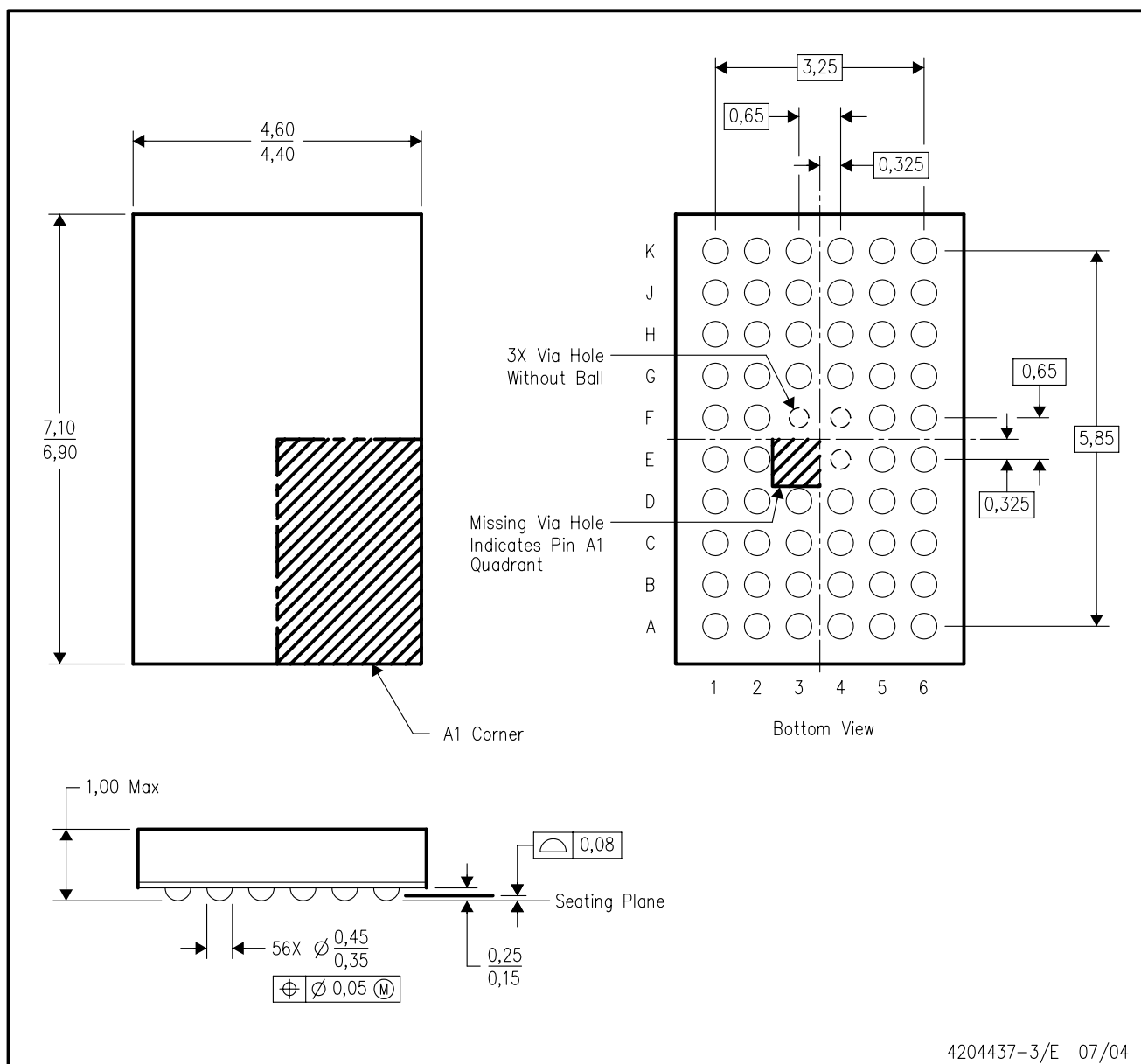


- NOTES:
- C_L includes probe and jig capacitance.
 - Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$.
 - The outputs are measured one at a time, with one 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} .
 - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

ZQL (R-PBGA-N56)

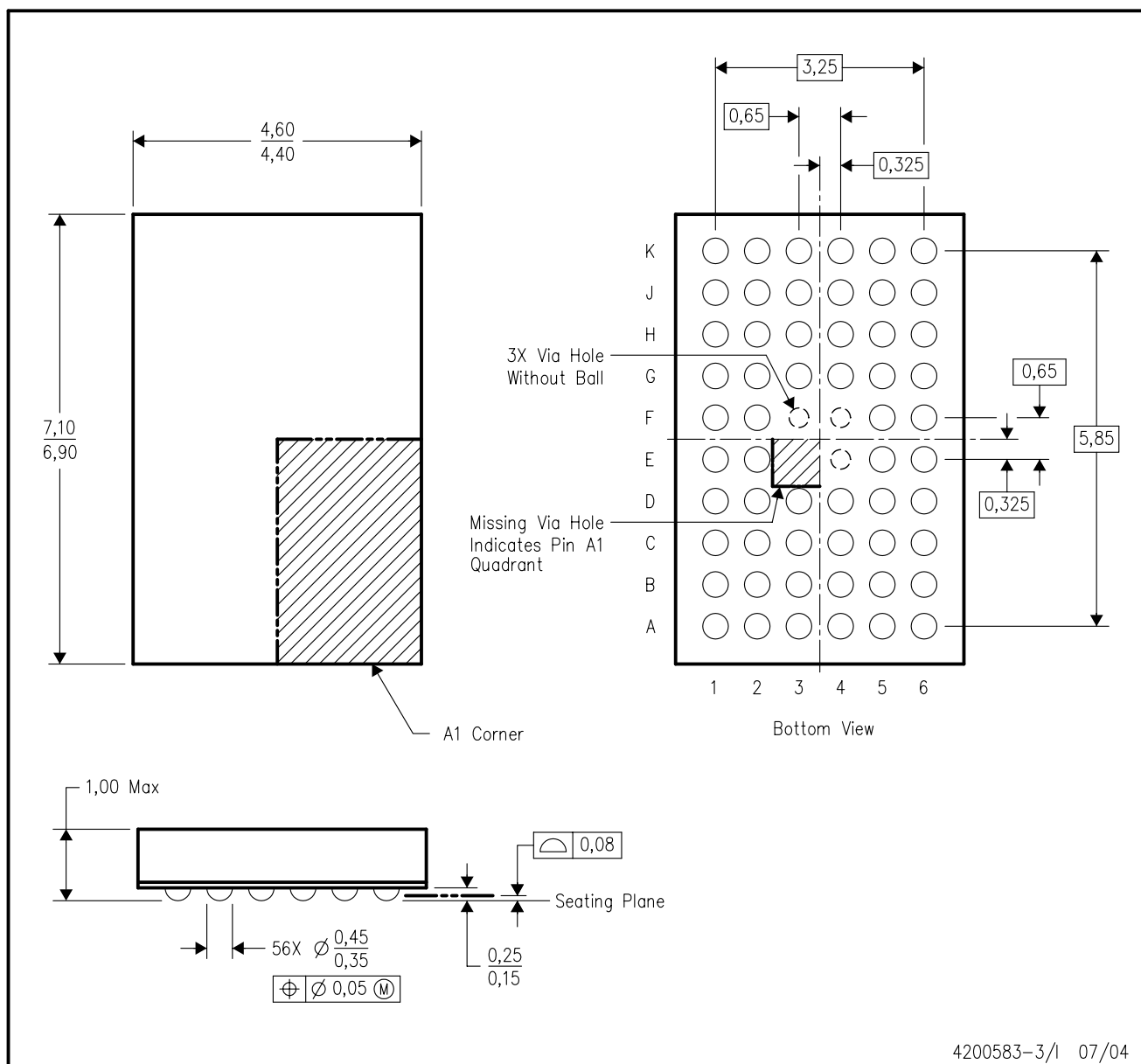
PLASTIC BALL GRID ARRAY



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Falls within JEDEC MO-225 variation BA.
 - This package is lead-free. Refer to the 56 GQL package (drawing 4200583) for tin-lead (SnPb).

GQL (R-PBGA-N56)

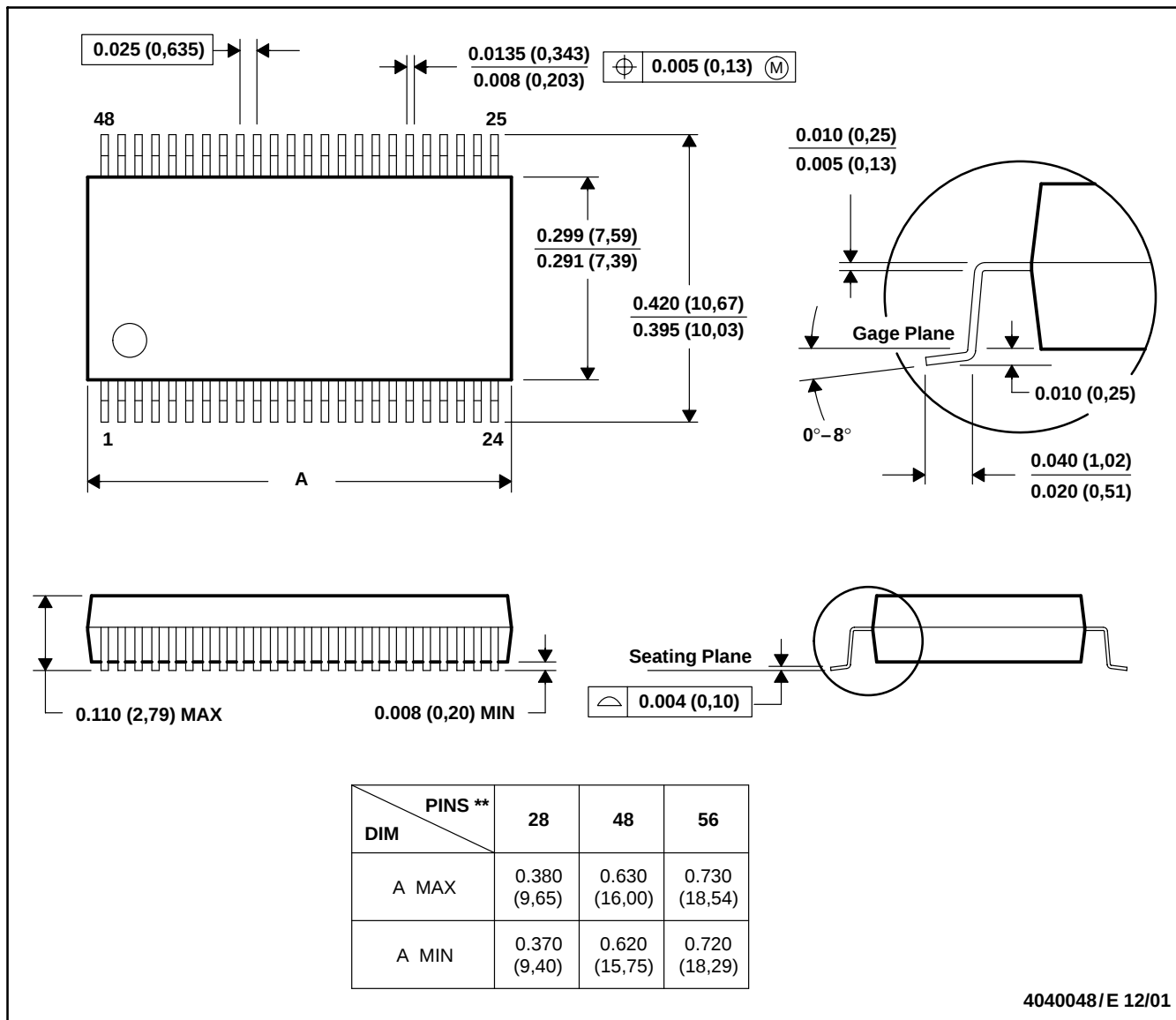
PLASTIC BALL GRID ARRAY



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.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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

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