

SN74LVC16245A

16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCES062N – DECEMBER 1995 – REVISED DECEMBER 2003

- Member of the Texas Instruments Widebus™ Family
- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max t_{pd} of 4 ns at 3.3 V
- Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot) >2 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V V_{CC})
- I_{off} Supports Partial-Power-Down Mode Operation
- 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)
 - 1000-V Charged-Device Model (C101)

description/ordering information

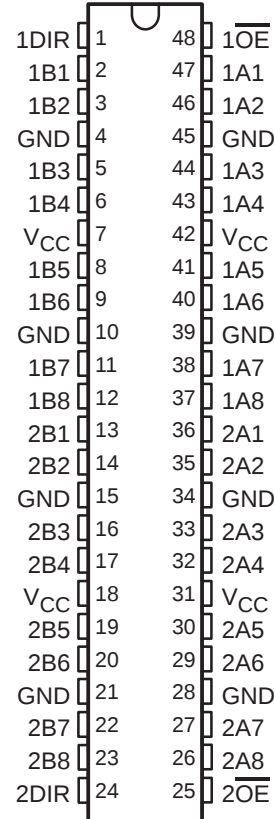
This 16-bit (dual-octal) noninverting bus transceiver is designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74LVC16245A is designed for asynchronous communication between data buses. The control-function implementation minimizes external timing requirements.

This device can be used as two 8-bit transceivers or one 16-bit transceiver. It allows data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the device so that the buses are effectively isolated.

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.

DGG, DGV, OR DL PACKAGE
(TOP VIEW)



ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP – DL	Tube	SN74LVC16245ADL	LVC16245A
		Tape and reel	SN74LVC16245ADLR	
	TSSOP – DGG	Tape and reel	SN74LVC16245ADGGR	LVC16245A
	TVSOP – DGV	Tape and reel	SN74LVC16245ADGVR	LD245A
	VFBGA – GQL	Tape and reel	SN74LVC16245AGQLR	LD245A
	VFBGA – ZQL (Pb-free)		SN74LVC16245AZQLR	

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



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SN74LVC16245A 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

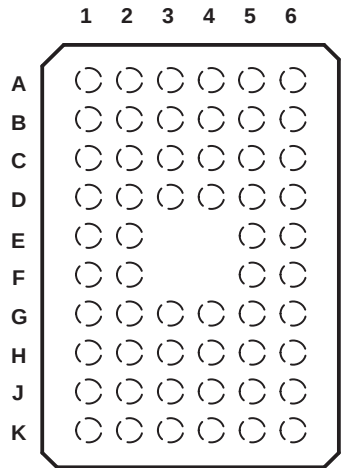
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description/ordering information (continued)

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of this device as a translator in a mixed 3.3-V/5-V system environment.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

GQL OR ZQL PACKAGE
(TOP VIEW)



terminal assignments

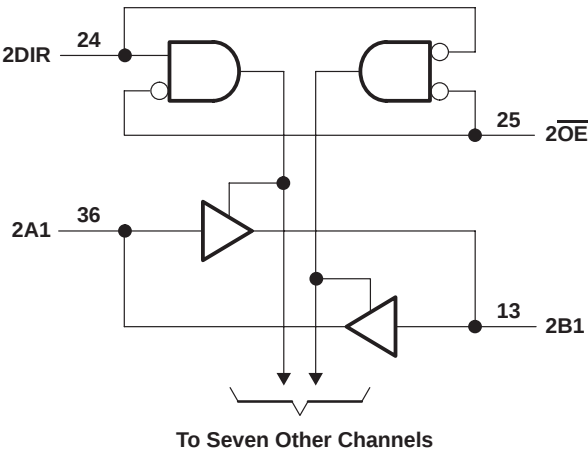
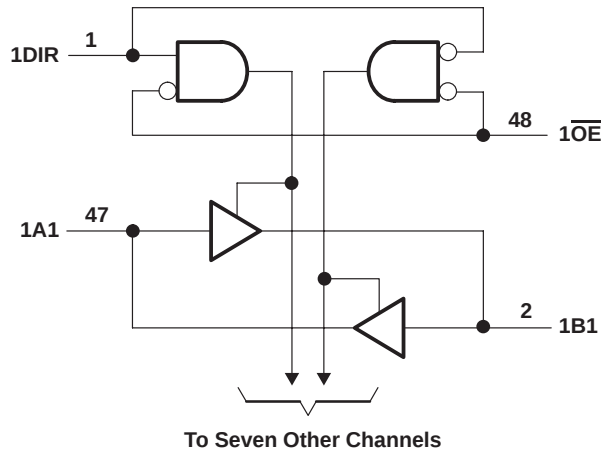
	1	2	3	4	5	6
A	1DIR	NC	NC	NC	NC	1OE
B	1B2	1B1	GND	GND	1A1	1A2
C	1B4	1B3	V _{CC}	V _{CC}	1A3	1A4
D	1B6	1B5	GND	GND	1A5	1A6
E	1B8	1B7			1A7	1A8
F	2B1	2B2			2A2	2A1
G	2B3	2B4	GND	GND	2A4	2A3
H	2B5	2B6	V _{CC}	V _{CC}	2A6	2A5
J	2B7	2B8	GND	GND	2A8	2A7
K	2DIR	NC	NC	NC	NC	2OE

NC – No internal connection

FUNCTION TABLE
(each 8-bit section)

INPUTS		OPERATION
OE	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

logic diagram (positive logic)



Pin numbers shown are for the DGG, DGV, and DL packages.

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SN74LVC16245A

16-BIT BUS TRANSCEIVER

WITH 3-STATE OUTPUTS

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	V _{CC}	MIN	TYP [†]	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} = -8 mA	2.3 V	1.7			
		I _{OH} = -12 mA	2.7 V	2.2			
			3 V	2.4			
		I _{OH} = -24 mA	3 V	2.2			
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} = 8 mA	2.3 V	0.7			
		I _{OL} = 12 mA	2.7 V	0.4			
		I _{OL} = 24 mA	3 V	0.55			
I _I	Control inputs	V _I = 0 to 5.5 V	3.6 V	±5			µA
I _{off}		V _I or V _O = 5.5 V	0	±10			µA
I _{OZ} [‡]		V _O = 0 to 5.5 V	2.3 V to 3.6 V	±5			µA
I _{CC}		V _I = V _{CC} or GND	3.6 V	20			µA
		3.6 V ≤ V _I ≤ 5.5 V [§]		20			
ΔI _{CC}		One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND	2.7 V to 3.6 V	500			µA
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V	5			pF
C _{io}	A or B ports	V _O = V _{CC} or GND	3.3 V	7.5			pF

[†] All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

[‡] For I/O ports, the parameter I_{OZ} includes the input leakage current.

[§] This applies in the disabled state only.

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

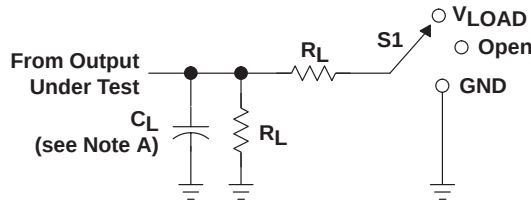
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 1.8 V ± 0.15 V		V _{CC} = 2.5 V ± 0.2 V		V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _{pd}	A or B	B or A	1.5	7.1	1	4.5	1	4.7	1	4	ns
t _{en}	$\overline{\text{OE}}$	A or B	1.5	8.9	1	5.6	1.5	6.7	1.5	5.5	ns
t _{dis}	$\overline{\text{OE}}$	A or B	1.5	11.9	1	6.8	1.5	7.1	1.5	6.6	ns
t _{sk(o)}										1	ns

operating characteristics, T_A = 25°C

PARAMETER			TEST CONDITIONS	V _{CC} = 1.8 V	V _{CC} = 2.5 V	V _{CC} = 3.3 V	UNIT
				TYP	TYP	TYP	
C _{pd}	Power dissipation capacitance per transceiver	Outputs enabled	f = 10 MHz	34	37	38	pF
		Outputs disabled		3	3	4	



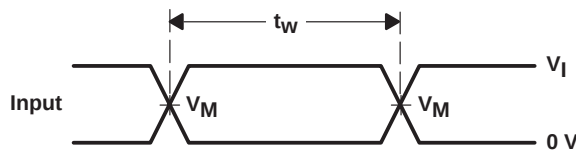
PARAMETER MEASUREMENT INFORMATION



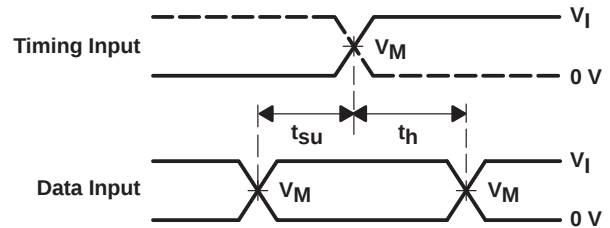
LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

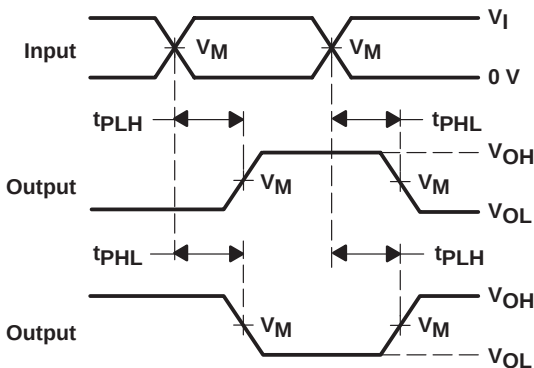
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_{Δ}
	V_I	t_r/t_f					
$1.8\text{ V} \pm 0.15\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k Ω	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	$\leq 2.5\text{ ns}$	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



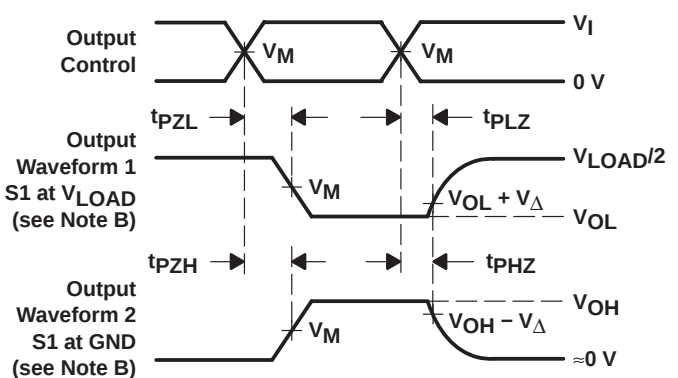
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



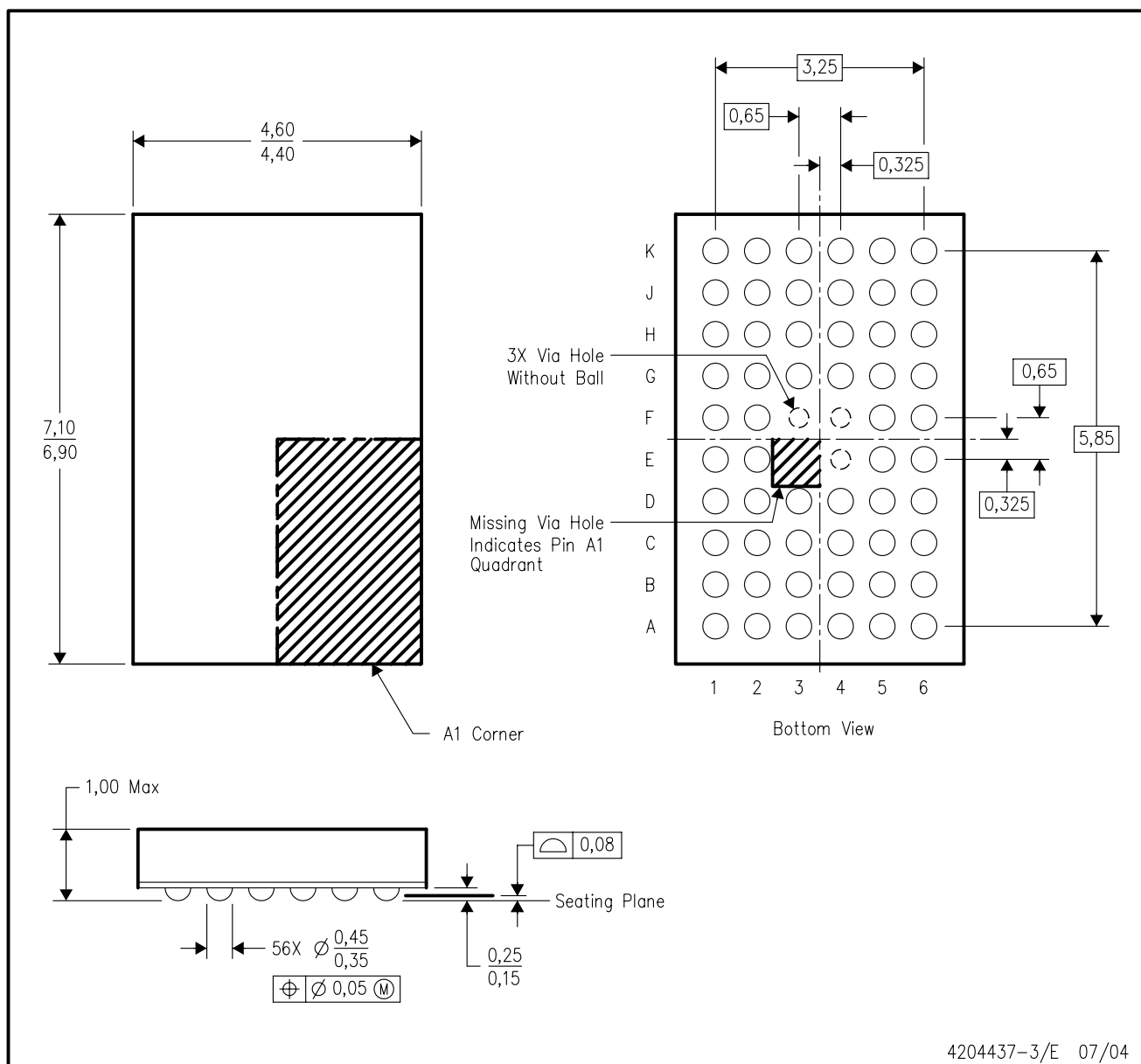
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- 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

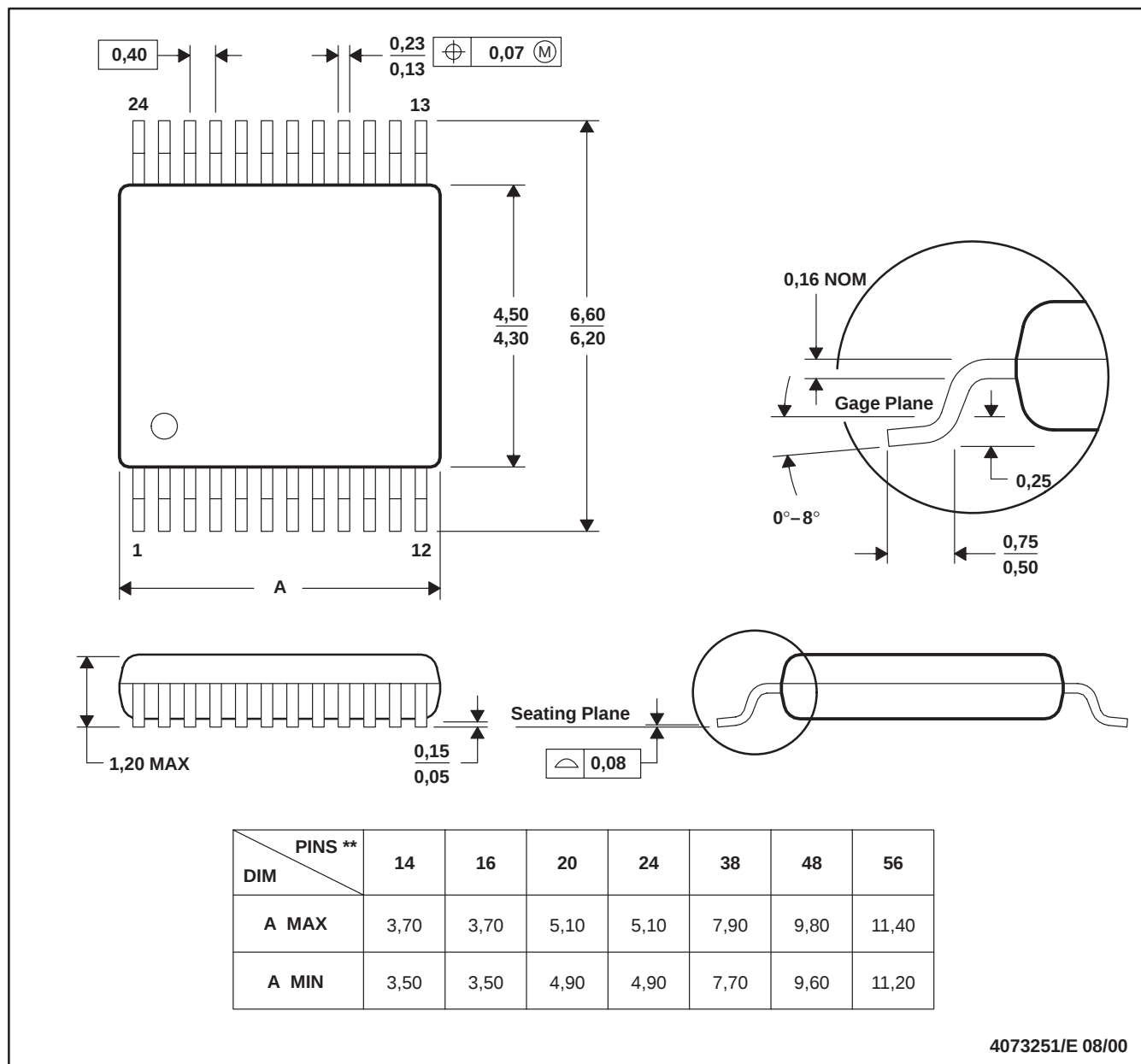


- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Falls within JEDEC MO-225 variation BA.
 - This package is lead-free. Refer to the 56 GQL package (drawing 4200583) for tin-lead (SnPb).

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

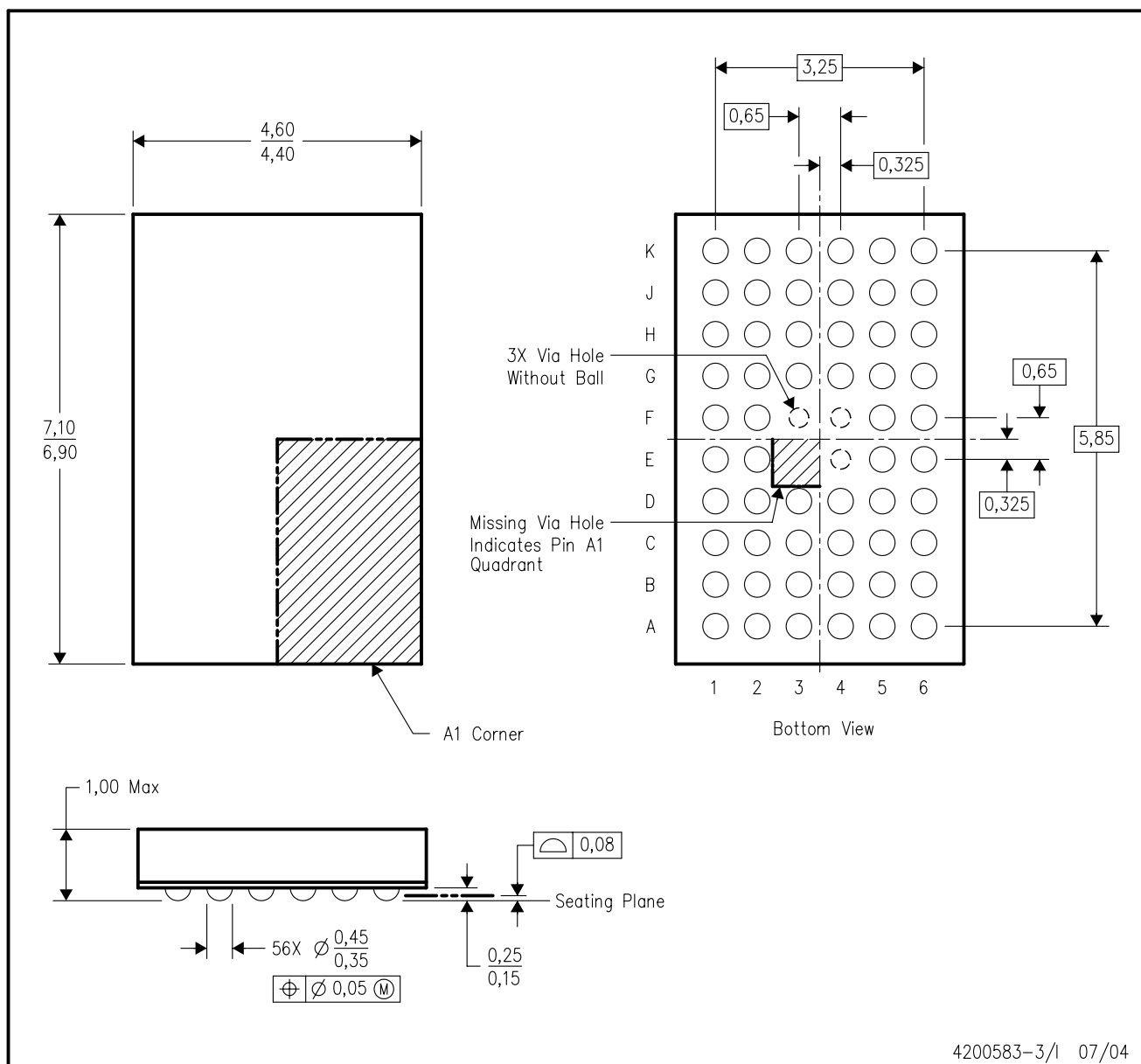
24 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

GQL (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 tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

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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