

SN74ALVC16245

16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS419D – JANUARY 1993 – REVISED AUGUST 1995

- **EPIC™** (Enhanced-Performance Implanted CMOS) Submicron Process
- **Member of the Texas Instruments Widebus™ Family**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages**

description

The SN74ALVC16245 16-bit (dual-octal) noninverting bus transceiver is designed for 2.3-V to 3.6-V V_{CC} operation; it is tested at 2.5-V, 2.7-V, and 3.3-V V_{CC} .

The SN74ALVC16245 is designed for asynchronous communication between data buses. The control-function implementation minimizes external timing requirements.

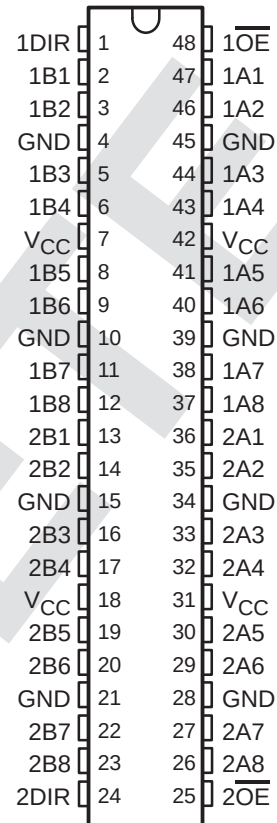
This device can be used as two 8-bit transceivers or one 16-bit transceiver. It allows data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the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

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

The SN74ALVC16245 is available in TI's shrink small-outline (DL) and thin shrink small-outline (DGG) packages, which provide twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The SN74ALVC16245 is characterized for operation from -40°C to 85°C .

**DGG OR DL PACKAGE
(TOP VIEW)**



**FUNCTION TABLE
(each 8-bit section)**

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation



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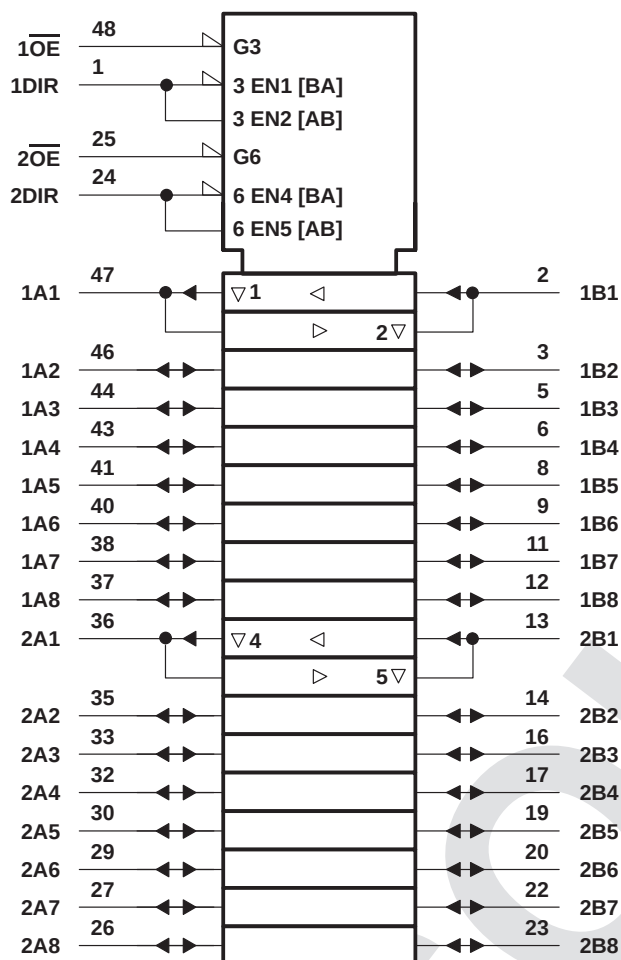
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**TEXAS
INSTRUMENTS**

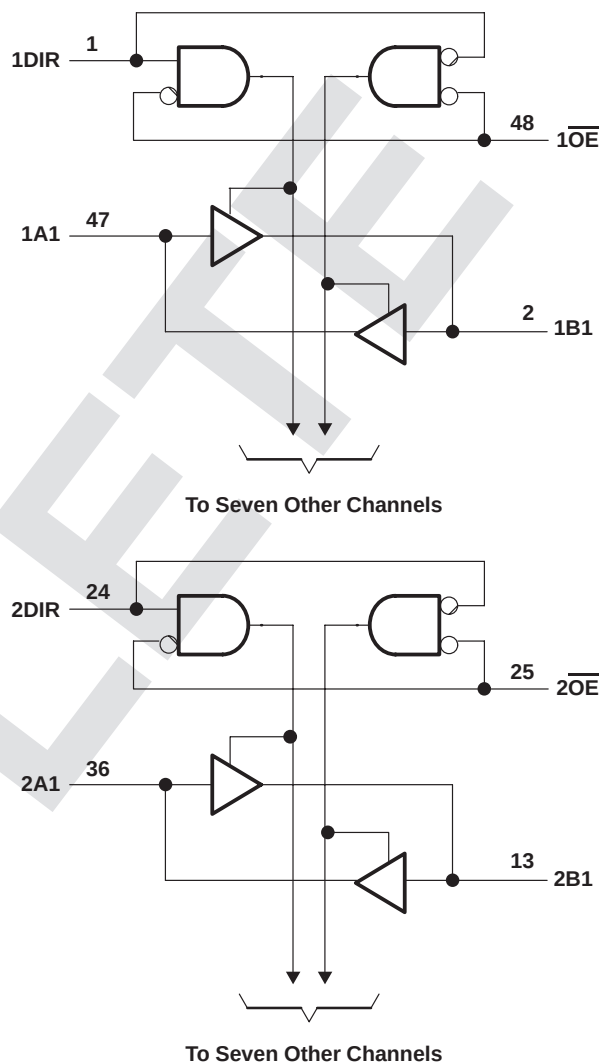
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logic symbol†



logic diagram (positive logic)



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

SN74ALVC16245
16-BIT BUS TRANSCEIVER
WITH 3-STATE OUTPUTS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC}	–0.5 V to 4.6 V
Input voltage range, V_I : Except I/O ports (see Note 1)	–0.5 V to $V_{CC} + 4.6$ V
I/O ports (see Notes 1 and 2)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, V_O (see Notes 1 and 2)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±50 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±50 mA
Continuous current through V_{CC} or GND	±100 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DGG package	0.85 W
DL package	1.2 W
Storage temperature range, T_{stg}	–65°C to 150°C

[†] 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.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 4.6 V maximum.
3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

recommended operating conditions (see Note 4)

		MIN	MAX	UNIT
V_{CC}	Supply voltage	2.3	3.6	V
V_{IH}	High-level input voltage	$V_{CC} = 2.3$ V to 2.7 V	1.7	V
		$V_{CC} = 2.7$ V to 3.6 V	2	
V_{IL}	Low-level input voltage	$V_{CC} = 2.3$ V to 2.7 V	0.7	V
		$V_{CC} = 2.7$ 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	$V_{CC} = 2.3$ V	–12	mA
		$V_{CC} = 2.7$ V	–12	
		$V_{CC} = 3$ V	–24	
I_{OL}	Low-level output current	$V_{CC} = 2.3$ V	12	mA
		$V_{CC} = 2.7$ V	12	
		$V_{CC} = 3$ V	24	
$\Delta t / \Delta v$	Input transition rise or fall rate	0	10	ns/V
T_A	Operating free-air temperature	–40	85	°C

NOTE 4: Unused control inputs must be held high or low to prevent them from floating.

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

PARAMETER		TEST CONDITIONS	V _{CC} [†]	T _A = −40°C to 85°C			UNIT
				MIN	TYP [‡]	MAX	
V _{OH}	I _{OH} = −100 μA		MIN to MAX	V _{CC} −0.2			V
	I _{OH} = −6 mA, V _{IH} = 1.7 V		2.3 V	2.0			
	I _{OH} = −12 mA	V _{IH} = 1.7 V	2.3 V	1.7			
		V _{IH} = 2 V	2.7 V	2.2			
		V _{IH} = 2 V	3 V	2.4			
	I _{OH} = −24 mA, V _{IH} = 2 V		3 V	2			
V _{OL}	I _{OL} = 100 μA		MIN to MAX	0.2			V
	I _{OL} = 6 mA, V _{IL} = 0.7 V		2.3 V	0.4			
	I _{OL} = 12 mA	V _{IL} = 0.7 V	2.3 V	0.7			
		V _{IL} = 0.8 V	2.7 V	0.4			
	I _{OL} = 24 mA, V _{IL} = 0.8 V		3 V	0.55			
I _I	V _I = V _{CC} or GND		3.6 V	±5			μA
I _{hold}	V _I = 0.7 V		2.3 V	45			μA
	V _I = 1.7 V			−45			
	V _I = 0.8 V		3 V	75			
	V _I = 2 V			−75			
I _{OZ} [§]		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}		V _{CC} = 3 V to 3.6 V, One input at V _{CC} − 0.6 V, Other inputs at V _{CC} or GND		750			μA
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V	4			pF
C _{io}	A or B ports	V _O = V _{CC} or GND	3.3 V	9			pF

[†] For conditions shown as MIN or MAX, use the appropriate values under recommended operating conditions.

[‡] All typical values are at $V_{CC} = 3.3\ \text{V}$.

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

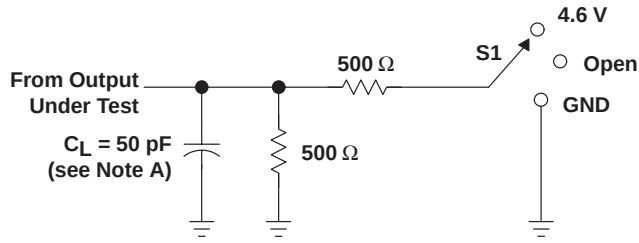
switching characteristics over recommended operating free-air temperature range, $C_L = 50\ \text{pF}$ (unless otherwise noted) (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 2.5\ \text{V} \pm 0.2\ \text{V}$		$V_{CC} = 2.7\ \text{V}$		$V_{CC} = 3.3\ \text{V} \pm 0.3\ \text{V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	B or A	1	5	4		1	3.6	ns
t_{en}	$\overline{OE}$	B or A	1	6.8	6		1	5	ns
t_{dis}	$\overline{OE}$	B or A	1	6	5.2		1	5	ns

operating characteristics, $T_A = 25^{\circ}\ \text{C}$

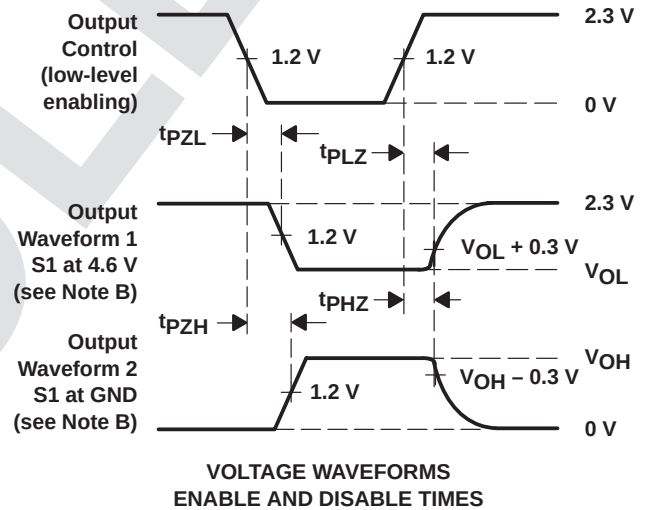
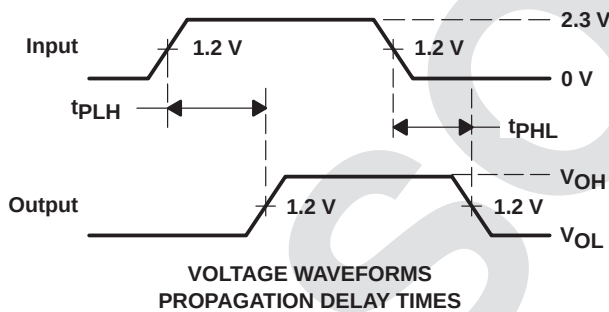
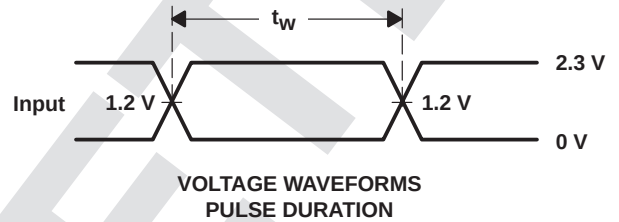
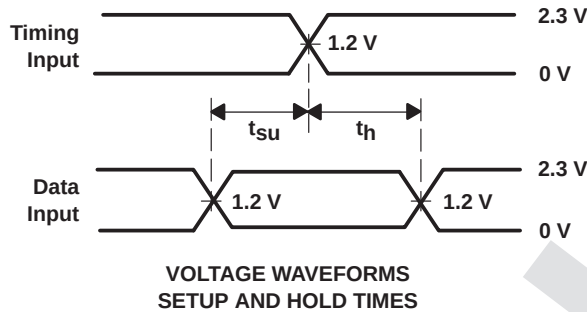
PARAMETER		TEST CONDITIONS	$V_{CC} = 2.5\ \text{V} \pm 0.2\ \text{V}$	$V_{CC} = 3.3\ \text{V} \pm 0.3\ \text{V}$	UNIT
			TYP	TYP	
C_{pd}	Power dissipation capacitance	$C_L = 50\ \text{pF}$, $f = 10\ \text{MHz}$	22	29	pF
	Outputs enabled Outputs disabled		4	5	

PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$



LOAD CIRCUIT

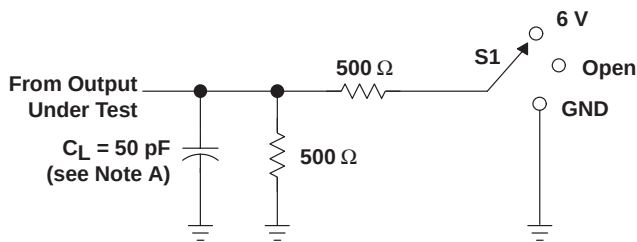
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	4.6 V
t_{PHZ}/t_{PZH}	GND



- 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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\text{ }\Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
 - 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} .

Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$

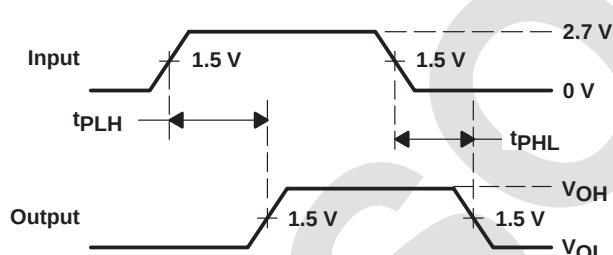


LOAD CIRCUIT

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



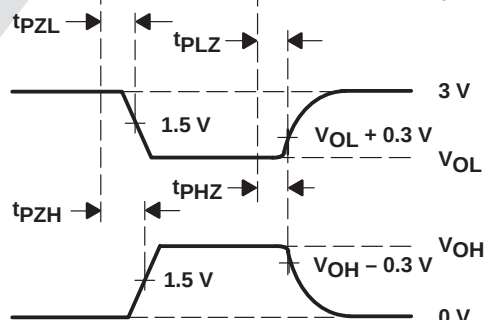
**VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS
PULSE DURATION**



**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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\text{ }\Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
 D. The outputs are measured one at a time with one 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 2. 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⁾
SN74ALVC16245DGGR	OBSOLETE	TSSOP	DGG	48		TBD	Call TI	Call TI
SN74ALVC16245DL	OBSOLETE	SSOP	DL	48		TBD	Call TI	Call TI
SN74ALVC16245DLR	OBSOLETE	SSOP	DL	48		TBD	Call TI	Call TI

⁽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) 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.

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.

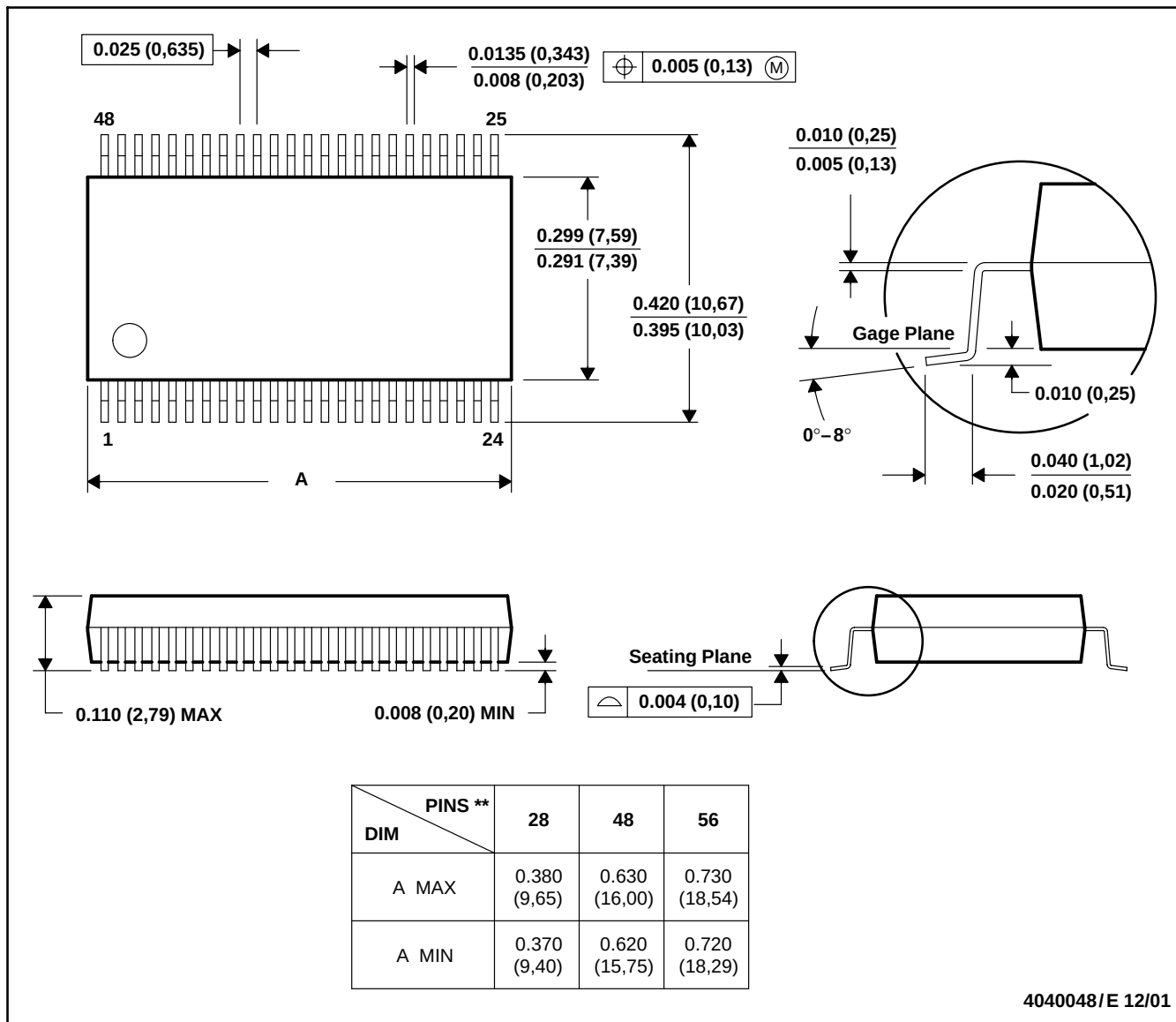
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DL (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN

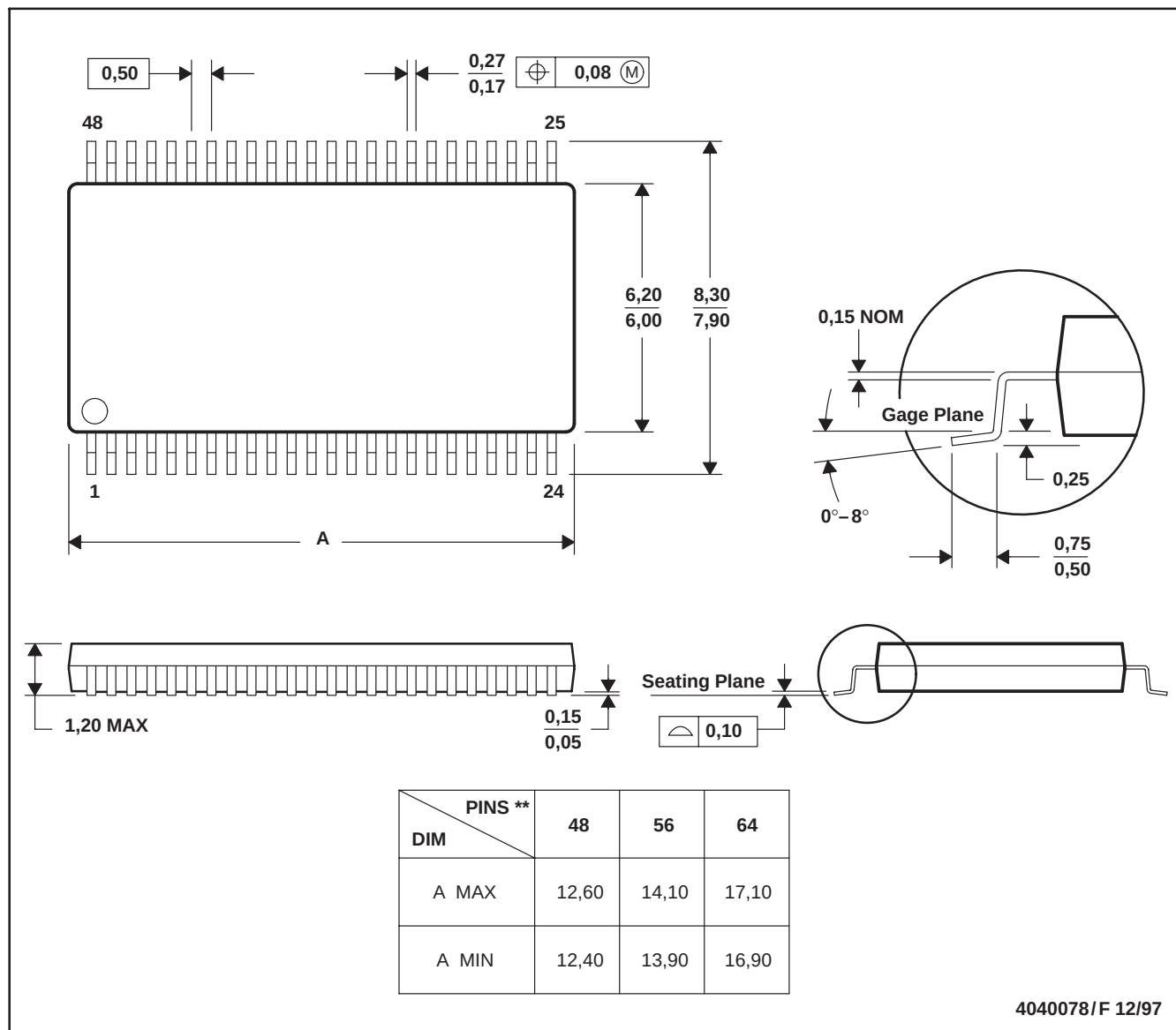


- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MO-118

DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



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