

- **1.4-k Ω Pullup Resistors Integrated on All Open-Drain Outputs Eliminate the Need for Discrete Resistors**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Designed for the IEEE Std 1284-I (Level 1 Type) and IEEE Std 1284-II (Level 2 Type) Electrical Specifications**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin-Shrink Small-Outline (DGG) Packages**

description/ordering information

The SN74LVC161284 is designed for 3-V to 3.6-V V_{CC} operation. This device provides asynchronous two-way communication between data buses. The control-function implementation minimizes external timing requirements.

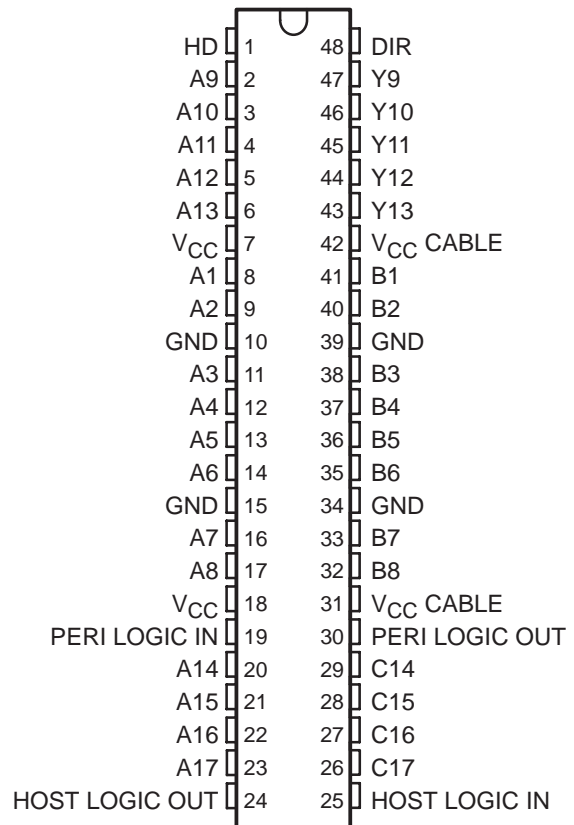
This device has eight bidirectional bits; data can flow in the A-to-B direction when DIR is high and in the B-to-A direction when DIR is low. This device also has five drivers, which drive the cable side, and four receivers. The SN74LVC161284 has one receiver dedicated to the HOST LOGIC line and a driver to drive the PERI LOGIC line.

The output drive mode is determined by the high-drive (HD) control pin. When HD is high, the outputs are in a totem-pole configuration, and in an open-drain configuration when HD is low. This meets the drive requirements as specified in the IEEE Std 1284-I (level 1 type) and IEEE Std 1284-II (level 2 type) parallel peripheral-interface specifications. Except for HOST LOGIC IN and PERI LOGIC OUT, all cable-side pins have a 1.4-k Ω integrated pullup resistor. The pullup resistor is switched off if the associated output driver is in the low state or if the output voltage is above V_{CC} CABLE. If V_{CC} CABLE is off, PERI LOGIC OUT is set to low.

The device has two supply voltages. V_{CC} is designed for 3-V to 3.6-V operation. V_{CC} CABLE supplies the inputs and output buffers of the cable side only and is designed for 3-V to 3.6-V and for 4.7-V to 5.5-V operation. Even when V_{CC} CABLE is 3 V to 3.6 V, the cable-side I/O pins are 5-V tolerant.

The SN74LVC161284 is characterized for operation from 0°C to 70°C.

DGG OR DL PACKAGE
(TOP VIEW)



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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SN74LVC161284

19-BIT BUS INTERFACE

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description/ordering information (continued)

ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	TSSOP – DGG	Tape and reel	SN74LVC161284DGGR	PACKAGE PREVIEW
	SSOP – DL	Tape	SN74LVC161284DL	LVC161284
		Tape and reel	SN74LVC161284DLR	
	TSSOP – DGG	Tape and reel	74LVC161284DGGRG4	PACKAGE PREVIEW
	SSOP – DL	Tape	74LVC161284DLRE4	LVC161284
		Tape and reel	74LVC161284DLRG4	

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

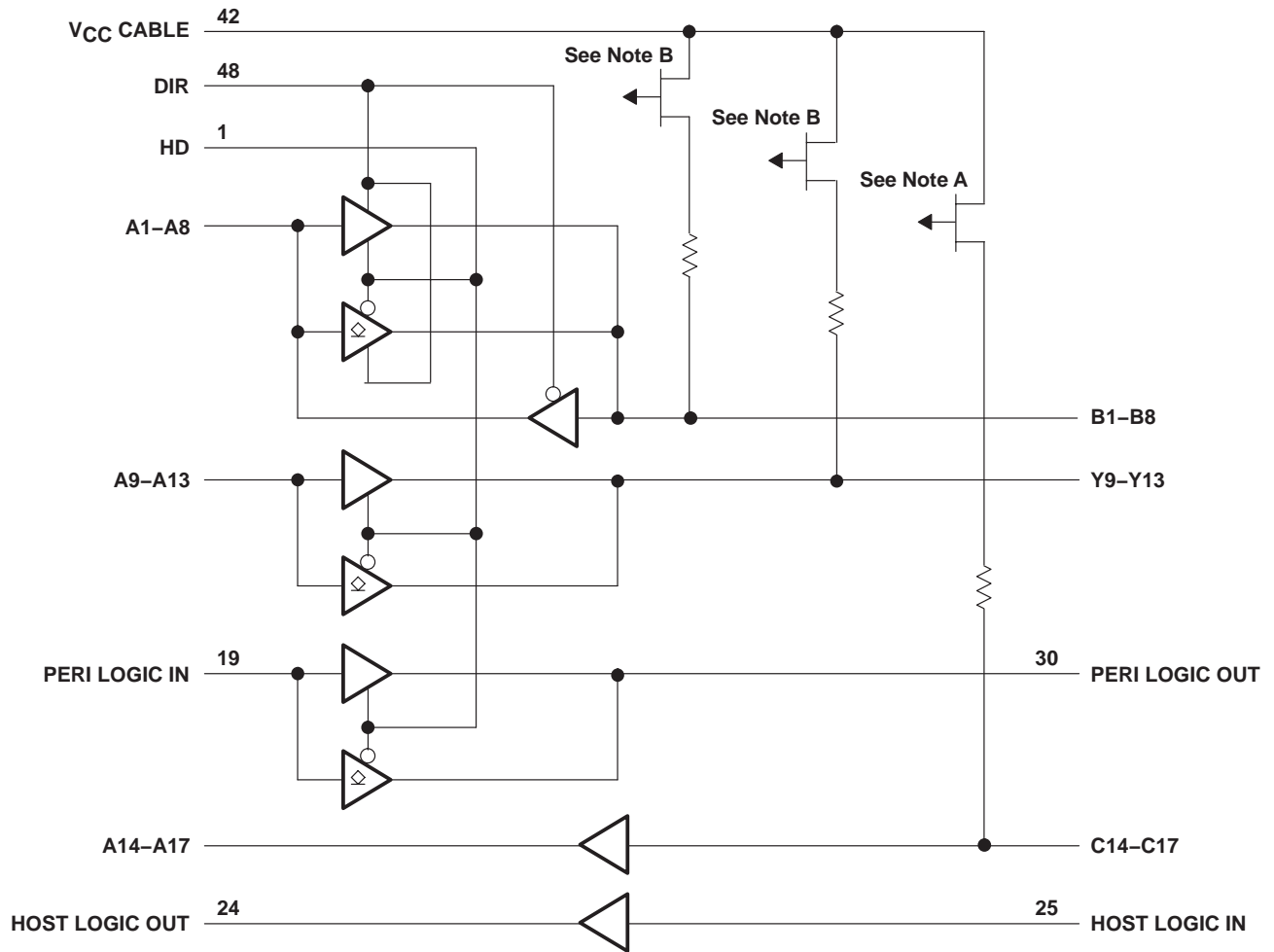
FUNCTION TABLE

INPUTS		OUTPUT	MODE
DIR	HD		
L	L	Open drain	A9–A13 to Y9–Y13 and PERI LOGIC IN to PERI LOGIC OUT
		Totem pole	B1–B8 to A1–A8 and C14–C17 to A14–A17
L	H	Totem pole	B1–B8 to A1–A8, A9–A13 to Y9–Y13, PERI LOGIC IN to PERI LOGIC OUT, and C14–C17 to A14–A17
H	L	Open drain	A1–A8 to B1–B8, A9–A13 to Y9–Y13, and PERI LOGIC IN to PERI LOGIC OUT
		Totem pole	C14–C17 to A14–A17
H	H	Totem pole	A1–A8 to B1–B8, A9–A13 to Y9–Y13, C14–C17 to A14–A17, and PERI LOGIC IN to PERI LOGIC OUT



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logic diagram



- NOTES: A. The PMOS transistor prevents backdriving current from the signal pins to V_{CC} CABLE when V_{CC} CABLE is open or at GND.
 B. The PMOS transistors prevent backdriving current from the signal pins to V_{CC} CABLE when V_{CC} CABLE is open or at GND. The PMOS transistor is turned off when the associated driver is in the low state.

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

Supply voltage range: V_{CC} CABLE	–0.5 V to 7 V
V_{CC}	–0.5 V to 4.6 V
Input and output voltage range, V_I and V_O : Cable side (see Notes 1 and 2)	–2 V to 7 V
Peripheral side (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–20 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Continuous output current, I_O : Except PERI LOGIC OUT	±50 mA
PERI LOGIC OUT	±100 mA
Continuous current through each V_{CC} or GND	±200 mA
Output high sink current, I_{SK} ($V_O = 5.5$ V and V_{CC} CABLE = 3 V)	65 mA
Package thermal impedance, θ_{JA} (see Note 3): DGG package	89°C/W
DL package	94°C/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 voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The ac input voltage pulse duration is limited to 40 ns if the amplitude is greater than –0.5 V.
 3. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V _{CC} CABLE	Supply voltage for the cable side, V _{CC} CABLE ≥ V _{CC}		3	5.5	V
V _{CC}	Supply voltage		3	3.6	V
V _{IH}	High-level input voltage	A, B, DIR, and HD	2		V
		C14–C17	2.3		
		HOST LOGIC IN	2.6		
		PERI LOGIC IN	2		
V _{IL}	Low-level input voltage	A, B, DIR, and HD	0.8		V
		C14–C17	0.8		
		HOST LOGIC IN	1.6		
		PERI LOGIC IN	0.8		
V _I	Input voltage	Peripheral side	0	V _{CC}	V
		Cable side	0	5.5	
V _O	Open-drain output voltage	HD low	0	5.5	V
I _{OH}	High-level output current	HD high, B and Y outputs	−14		mA
		A outputs and HOST LOGIC OUT	−4		
		PERI LOGIC OUT	−0.5		
I _{OL}	Low-level output current	B and Y outputs	14		mA
		A outputs and HOST LOGIC OUT	4		
		PERI LOGIC OUT	84		
T _A	Operating free-air temperature		0	70	°C

NOTE 4: All unused 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,
V_{CC} CABLE = 5 V (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	V _{CC}	MIN	TYP†	MAX	UNIT
ΔV_t	Input hysteresis	V _{thH} – V _{thL} for all inputs except the C inputs and HOST LOGIC IN	3.3 V	0.4			V
		V _{thH} – V _{thL} for the HOST LOGIC IN	3.3 V	0.2			
		V _{thH} – V _{thL} for the C inputs	3.3 V	0.8			
V _{OH}	HD high, B and Y outputs	I _{OH} = –14 mA	3 V	2.23			V
			3.3 V‡	2.4			
	HD high, A outputs, and HOST LOGIC OUT	I _{OH} = –4 mA	3 V	2.4			
		I _{OH} = –50 µA	3 V	2.8			
	PERI LOGIC OUT	I _{OH} = –0.5 mA	3.15 V	3.1			
			3.3 V‡	4.5			
V _{OL}	B and Y outputs	I _{OL} = 14 mA	3 V			0.77	V
	A outputs and HOST LOGIC OUT	I _{OL} = 50 µA	3 V			0.2	
		I _{OL} = 4 mA	3 V			0.4	
	PERI LOGIC OUT	I _{OL} = 84 mA	3 V			0.8	
I _I	C inputs	V _I = V _{CC}	3.6 V§			50	µA
		V _I = GND (pullup resistors)	3.6 V§			–3.5	mA
	All inputs except the B or C inputs	V _I = V _{CC} or GND	3.6 V			±1	µA
I _{OZ}	B outputs	V _O = V _{CC}	3.6 V			20	µA
		V _O = GND (pullup resistors)	3.6 V§			–3.5	mA
	A1–A8	V _O = V _{CC} or GND	3.6 V			±20	µA
	Open-drain Y outputs	V _O = GND (pullup resistors)	3.6 V§			–3.5	mA
I _{off}	Leakage to GND, B and Y outputs	V _I or V _O = 0 to 7 V	0 V			100	µA
	Leakage to V _{CC} , B and Y outputs					10	
I _{CC} ¶		V _I = V _{CC} , I _O = 0	3.6 V			0.8	mA
		V _I = GND (12 × pullup)	3.6 V			45	
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V		3	4	pF
C _{io}	All inputs	V _O = V _{CC} or GND	3.3 V		7	15	pF
Z _O	Cable side	I _{OH} = –35 mA	3.3 V		45		Ω
R pullup	Cable side	V _O = 0 V (in Hi Z)	3.3 V	1.15		1.65	kΩ

† Typical values are measured at V_{CC} = 3.3 V, V_{CC} CABLE = 5 V, and T_A = 25°C.

‡ V_{CC} CABLE = 4.7 V

§ V_{CC} CABLE = 3.6 V

¶ A maximum current of 170 µA per pin is added to I_{CC} if the pullup resistor pin is above V_{CC}.

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switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figures 1 and 2)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	MIN	TYP†	MAX	UNIT
t _{PLH}	Totem pole	A or B	B or A	1		40	ns
t _{PHL}				1		40	
t _{slew}	Totem pole	Cable-side outputs		0.05		0.4	V/ns
t _{en}	Totem pole	HD	B, Y, and PERI LOGIC OUT	1		25	ns
t _{dis}	Totem pole	HD	B, Y, and PERI LOGIC OUT	1		25	ns
t _{en} –t _{dis}				1		10	ns
t _{en}		DIR	A	1		50	ns
t _{dis}		DIR	A	1		15	ns
			B	1		50	
t _r , t _f	Open drain	A	B or Y			120	ns
t _{sk(o)} ‡		A or B	B or A		2.5	10	ns

† Typical values are measured at V_{CC} = 3.3 V, V_{CC CABLE} = 5 V, and T_A = 25°C.

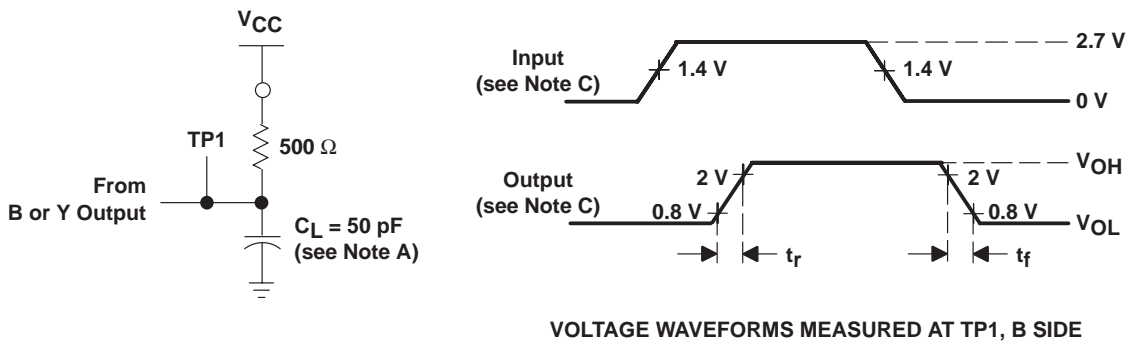
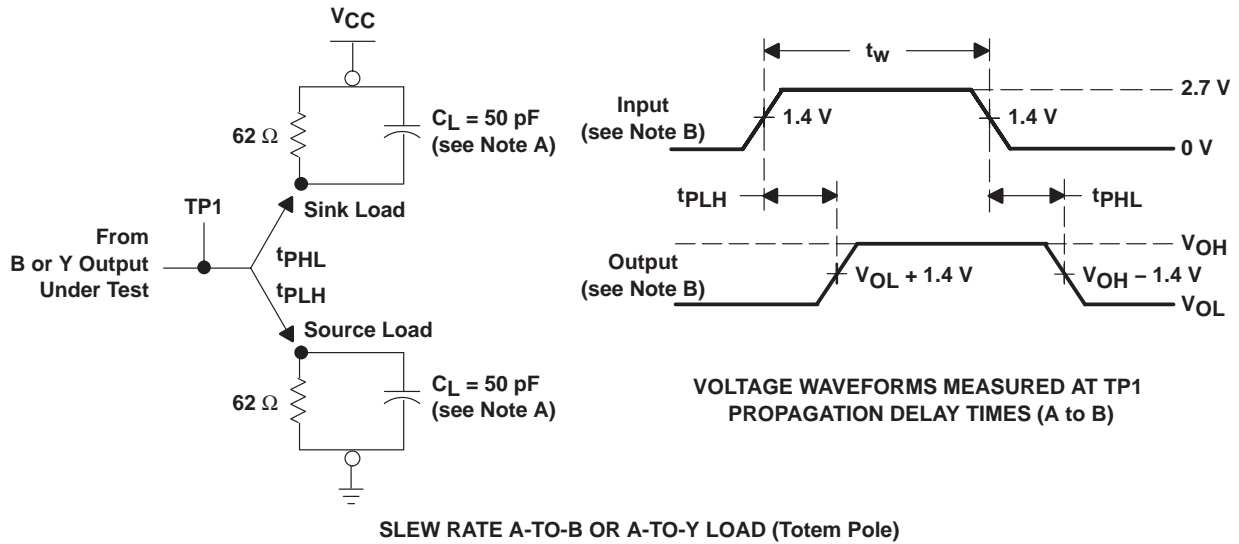
‡ Skew is measured at 1/2 (V_{OH} + V_{OL}) for signals switching in the same direction.

operating characteristics, V_{CC} = 3.3 V, T_A = 25°C

PARAMETER			TEST CONDITIONS	TYP	UNIT
C _{pd}	Power dissipation capacitance	Outputs enabled	C _L = 0, f = 10 MHz	45	pF



PARAMETER MEASUREMENT INFORMATION



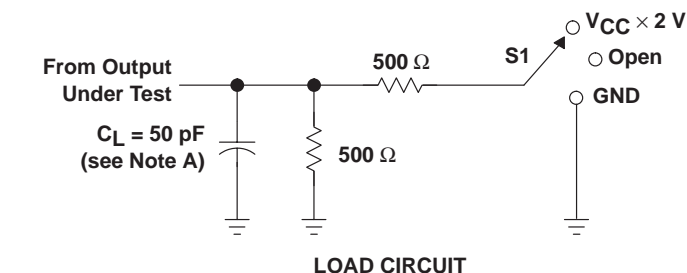
- NOTES: A. C_L includes probe and jig capacitance.
 B. Input rise and fall times are 3 ns, $150 \text{ ns} < \text{pulse duration} < 10 \text{ } \mu\text{s}$ for both low-to-high and high-to-low transitions. Slew rate is measured between 0.4 V and 0.9 V for the rising edge and between 2.4 V and 1.9 V for the falling edge.
 C. Input rise and fall times are 3 ns. Rise and fall times (open drain) $< 120 \text{ ns}$.
 D. The outputs are measured one at a time, with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

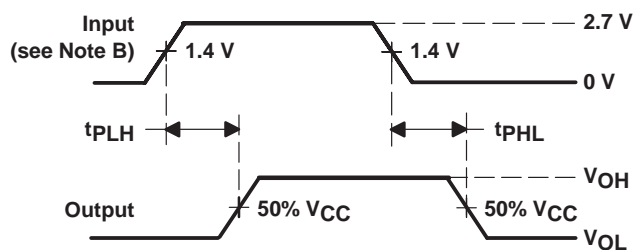
SN74LVC161284 19-BIT BUS INTERFACE

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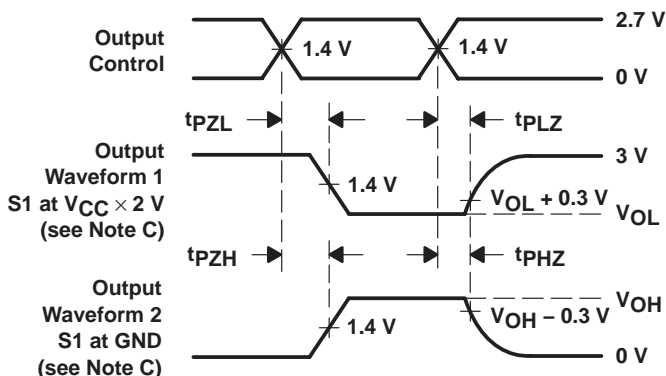
PARAMETER MEASUREMENT INFORMATION



TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	$V_{CC} \times 2 \text{ V}$
t_{PHZ}/t_{PZH}	GND

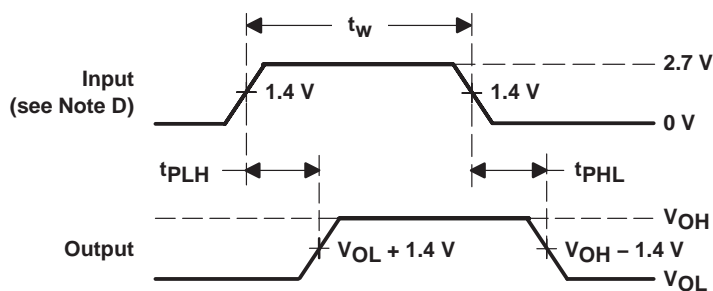
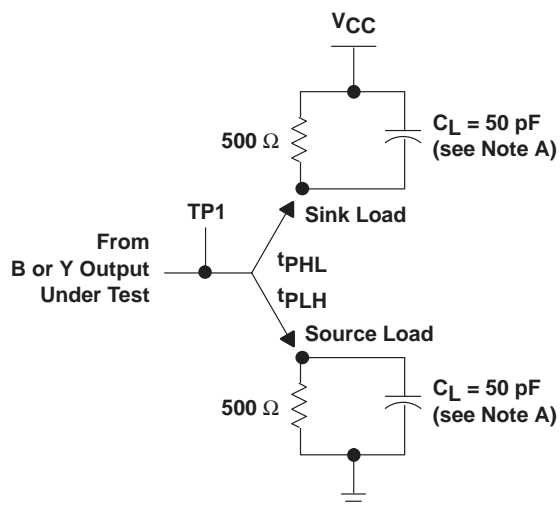


VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES (B to A)



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

B-TO-A LOAD (Totem Pole)



VOLTAGE WAVEFORMS MEASURED AT TP1
PROPAGATION DELAY TIMES (A to B)

A-TO-B LOAD OR A-TO-Y LOAD (Totem Pole)

- NOTES:
- C_L includes probe and jig capacitance.
 - Input rise and fall times are 3 ns.
 - 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.
 - Input rise and fall times are 3 ns. Pulse duration is $150 \text{ ns} < t_w < 10 \mu\text{s}$.
 - The outputs are measured one at a time, with one transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74LVC161284DGGR	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	LVC161284
SN74LVC161284DGGR.A	Active	Production	TSSOP (DGG) 48	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	LVC161284
SN74LVC161284DL	Active	Production	SSOP (DL) 48	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	LVC161284
SN74LVC161284DL.A	Active	Production	SSOP (DL) 48	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	LVC161284
SN74LVC161284DLR	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	LVC161284
SN74LVC161284DLR.A	Active	Production	SSOP (DL) 48	1000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	LVC161284

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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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
SN74LVC161284DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1
SN74LVC161284DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1

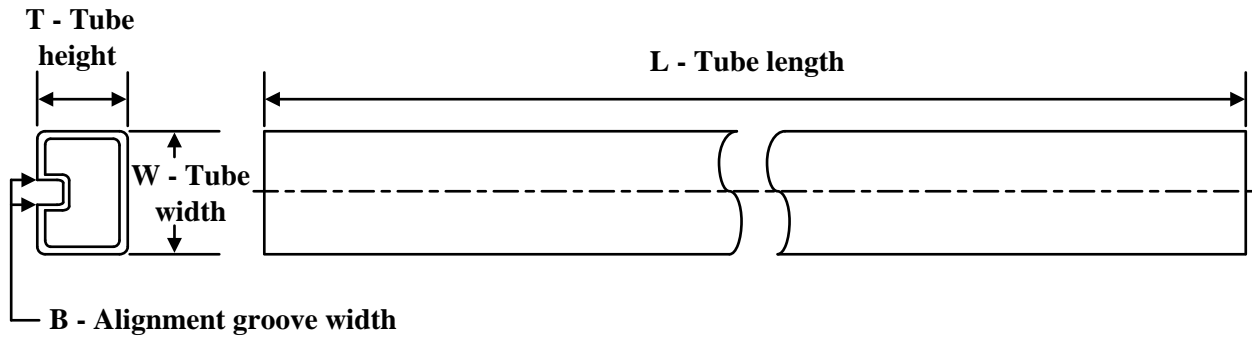
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC161284DGGR	TSSOP	DGG	48	2000	356.0	356.0	45.0
SN74LVC161284DLR	SSOP	DL	48	1000	356.0	356.0	53.0

TUBE

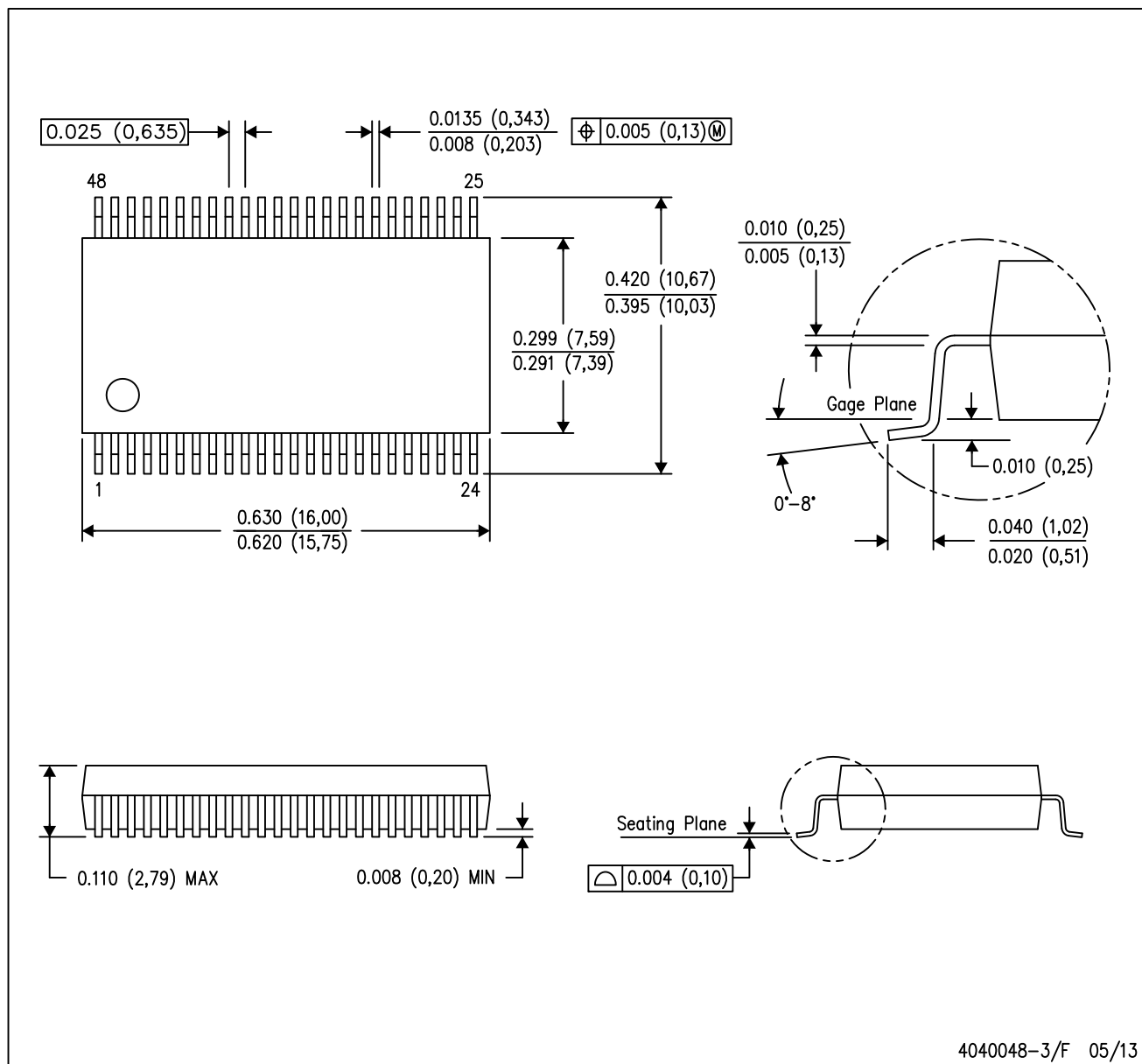


*All dimensions are nominal

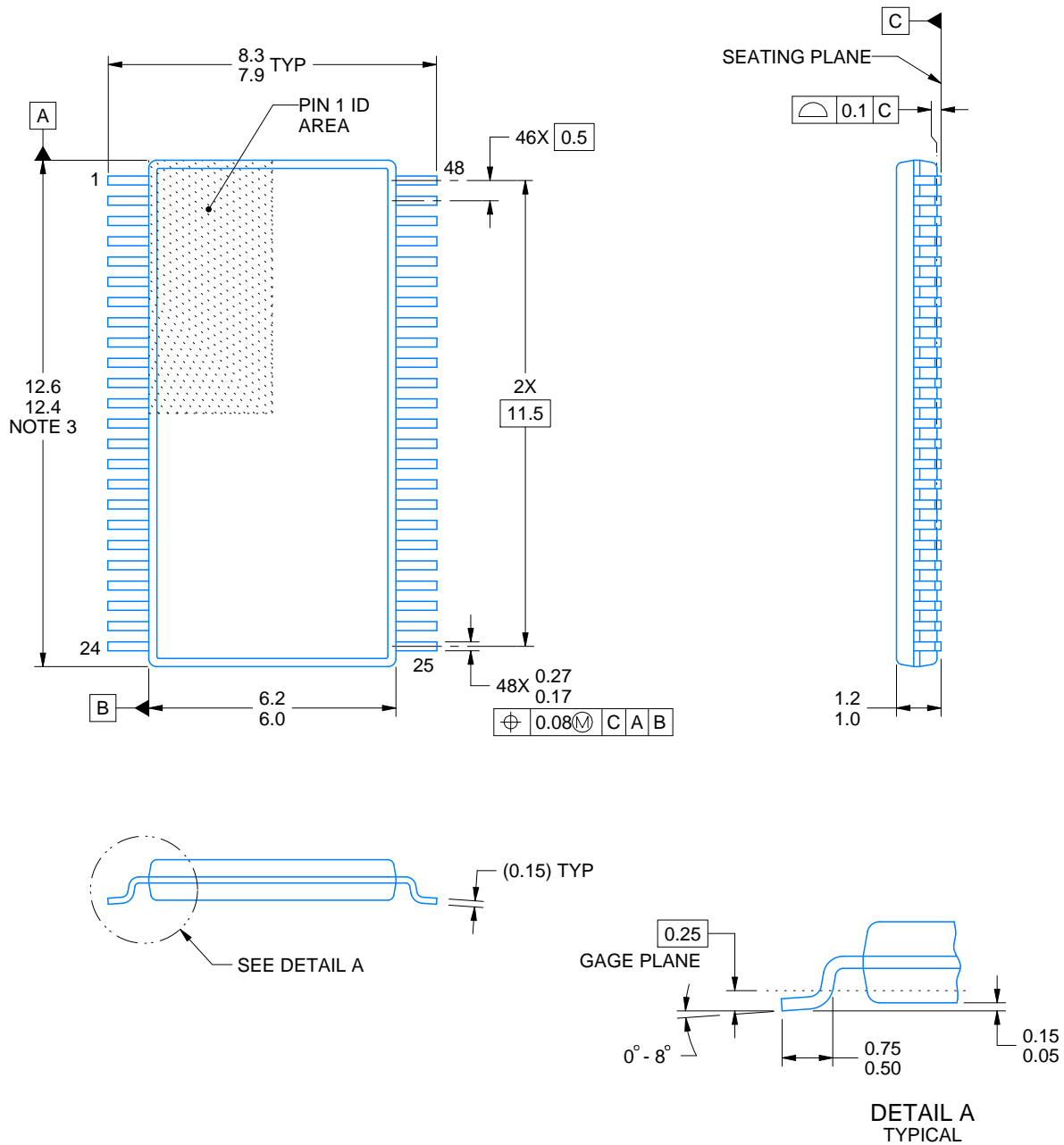
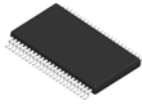
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN74LVC161284DL	DL	SSOP	48	25	473.7	14.24	5110	7.87
SN74LVC161284DLA	DL	SSOP	48	25	473.7	14.24	5110	7.87

DL (R-PDSO-G48)

PLASTIC SMALL-OUTLINE PACKAGE



- 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



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NOTES:

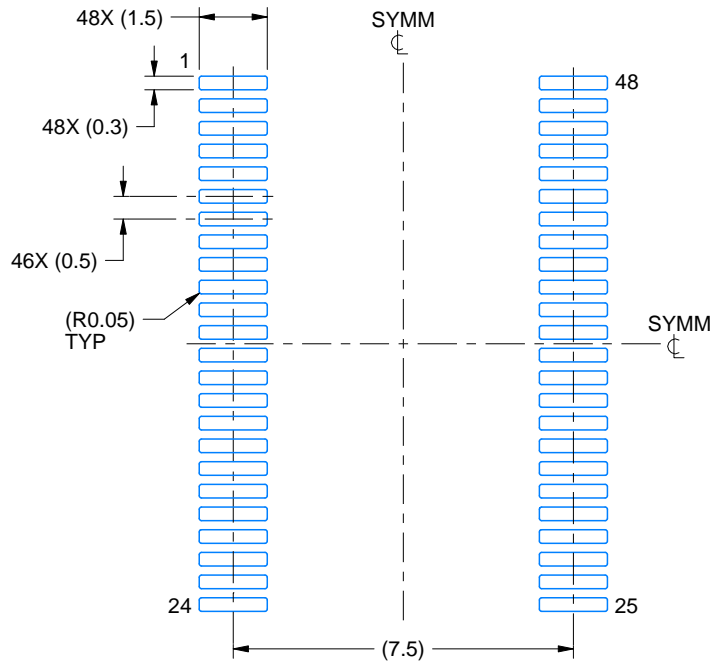
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

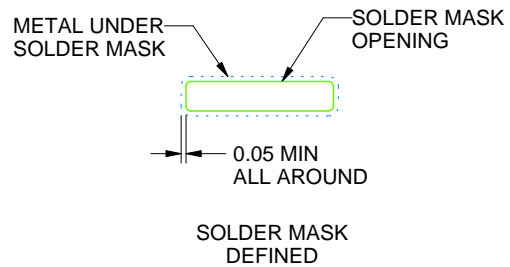
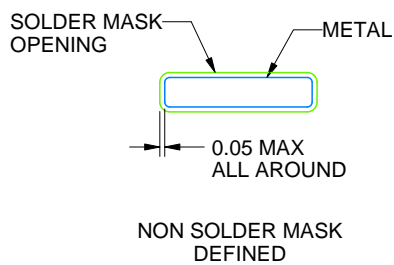
DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

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NOTES: (continued)

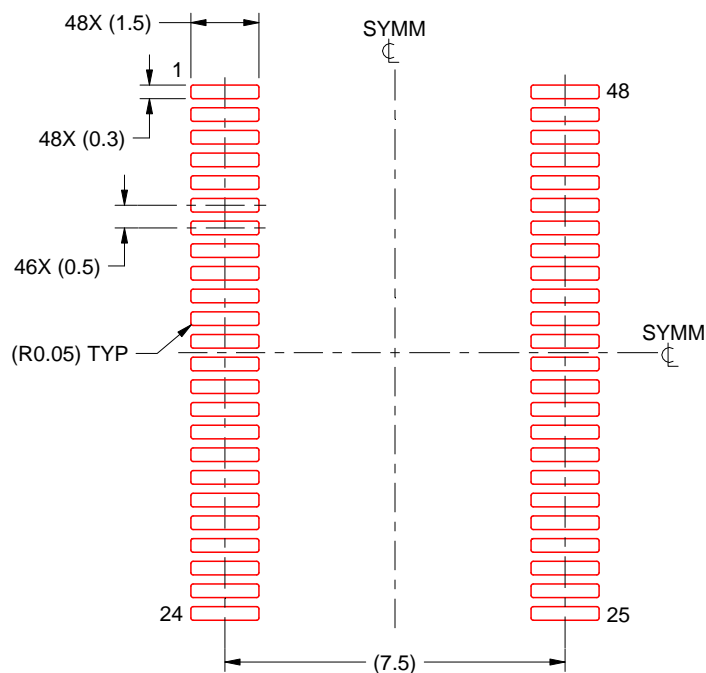
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

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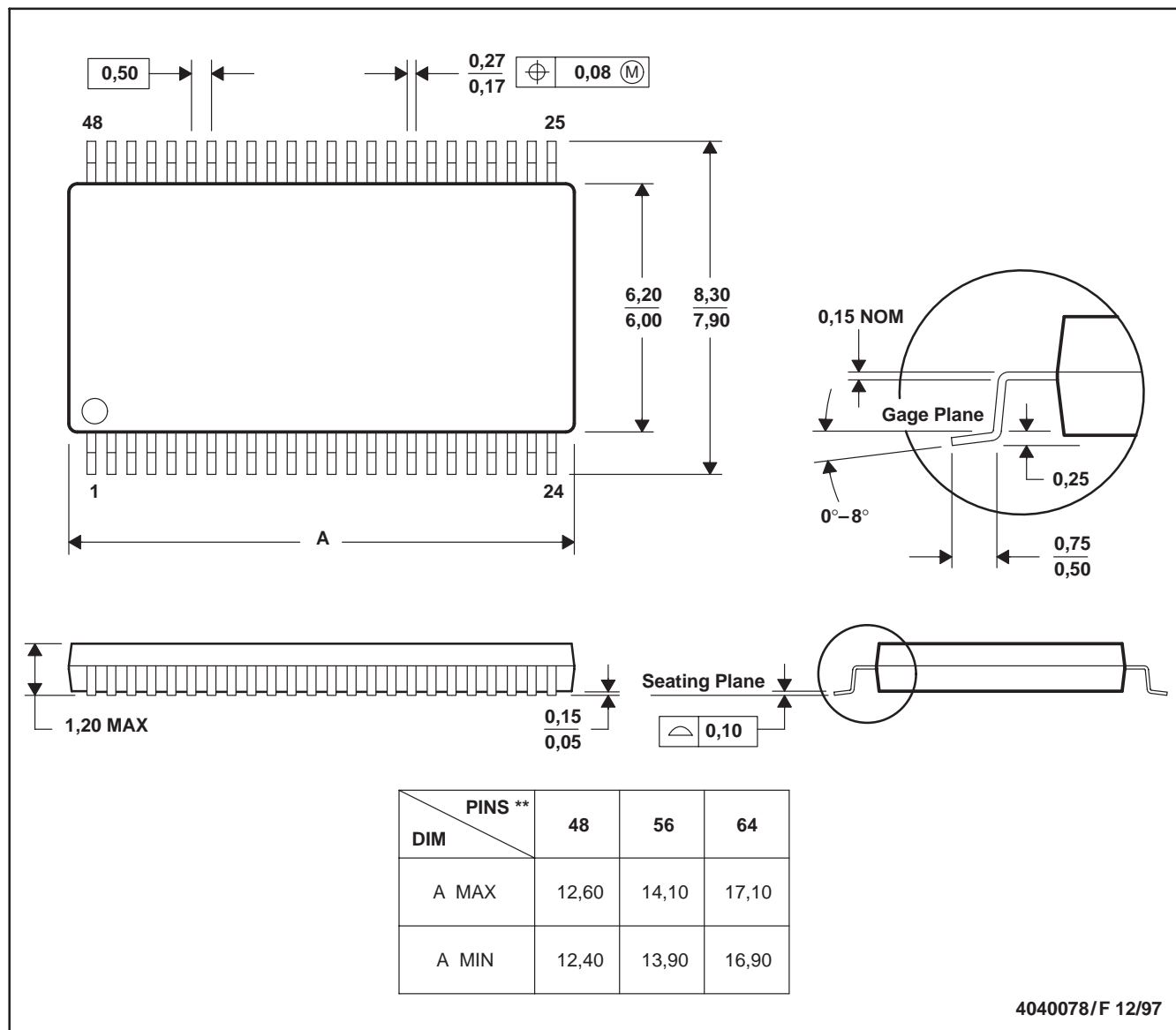
NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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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