

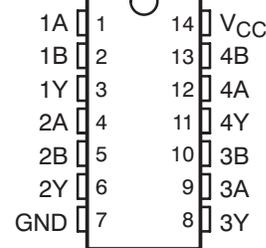
QUADRUPLE POSITIVE-NAND GATES WITH SCHMITT-TRIGGER INPUTS

 Check for Samples: [SN54LV132A](#), [SN74LV132A](#)

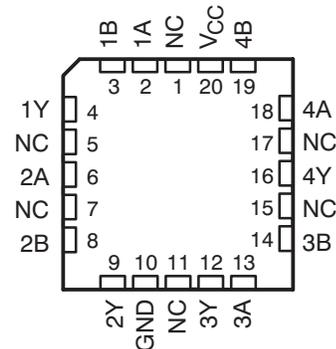
FEATURES

- 2-V to 5.5-V V_{CC} Operation
- Max t_{pd} of 9 ns at 5 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) > 2.3 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Support Mixed-Mode Voltage Operation on All Ports
- 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)

SN54LV132A...JO OR W PACKAGE
SN74LV132A...D, DB, DGV, NS, OR PW PACKAGE
(TOP VIEW)



SN54LV132A...FK PACKAGE
(TOP VIEW)



NC – No internal connection

DESCRIPTION

The 'LV132A devices are quadruple positive-NAND gates designed for 2-V to 5.5-V V_{CC} operation.

The 'LV132A devices perform the Boolean function $Y = \overline{A \cdot B}$ or $Y = \overline{A} + \overline{B}$ in positive logic.

Each circuit functions as a NAND gate, but because of the Schmitt action, it has different input threshold levels for positive- and negative-going signals.

These circuits are temperature compensated and can be triggered from the slowest of input ramps and still give clean jitter-free output signals.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

ORDERING INFORMATION⁽¹⁾

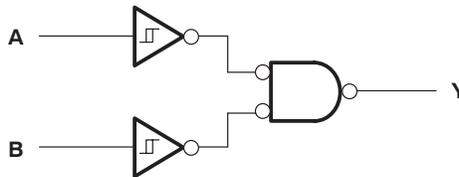
T _A	PACKAGE ⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SOIC – D	Tube of 25	SN74LV132AD	LV132A
		Reel of 2500	SN74LV132ADR	
	SOP – NS	Reel of 2000	SN74LV132ANSR	74LV132A
	SSOP – DB	Reel of 2000	SN74LV132ADBR	LV132A
	TSSOP – PW	Tube of 90	SN74LV132APW	LV132A
		Reel of 2000	SN74LV132APWR	
		Reel of 250	SN74LV132APWT	
TVSOP – DGV	Reel of 2000	SN74LV132ADGVR	LV132A	
-55°C to 125°C	CDIP – J	Tube of 25	SNJ54LV132AJ ⁽³⁾	SNJ54LV132AJ
	CFP – W	Tube of 150	SNJ54LV132AW ⁽³⁾	SNJ54LV132AW
	LCCC – FK	Tube of 55	SNJ54LV132AFK ⁽³⁾	SNJ54LV132AFK

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
- (2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
- (3) Product Preview

FUNCTION TABLE

INPUTS		OUTPUT
A	B	Y
H	H	L
L	X	H
X	L	H

LOGIC DIAGRAM (POSITIVE LOGIC)



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

over operating free-air temperature (unless otherwise noted)

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	-0.5	7	V
V_I	Input voltage range ⁽²⁾	-0.5	7	V
V_O	Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾	-0.5	7	V
V_O	Output voltage range ^{(2) (3)}	-0.5	$V_{CC} + 0.5$	V
I_{IK}	Input clamp current	$V_I < 0$	-20	mA
I_{OK}	Output clamp current	$V_O < 0$	-50	mA
I_O	Continuous output current	$V_O = 0$ to V_{CC}	±25	mA
	Continuous current through V_{CC} or GND		±50	mA
θ_{JA}	Package thermal impedance ⁽⁴⁾	D package	86	°C/W
		DB package	96	
		DGV package	127	
		NS package	76	
		PW package	113	
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 and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value is limited to 5.5 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

		SN54LV132A ⁽²⁾		SN74LV132A		UNIT
		MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	2	5.5	2	5.5	V
V_I	Input voltage	0	5.5	0	5.5	V
V_O	Output voltage	0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 2$ V	-50	-50	μA	
		$V_{CC} = 2.3$ V to 2.7 V	-2	-2	mA	
		$V_{CC} = 3$ V to 3.6 V	-6	-6		
		$V_{CC} = 4.5$ V to 5.5 V	-12	-12		
I_{OL}	Low-level output current	$V_{CC} = 2$ V	50	50	μA	
		$V_{CC} = 2.3$ V to 2.7 V	2	2	mA	
		$V_{CC} = 3$ V to 3.6 V	6	6		
		$V_{CC} = 4.5$ V to 5.5 V	12	12		
T_A	Operating free-air temperature	-55	125	-40	85	°C

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. See the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number [SCBA004](#).
- (2) Product Preview

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	V _{CC}	SN54LV132A ⁽¹⁾			SN74LV132A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V _{T+} Positive-going input threshold voltage		2.5 V	1		1.75	1		1.75	V
		3.3 V	1.31		2.31	1.31		2.31	
		5 V	1.95		3.5	1.95		3.5	
V _{T-} Negative-going input threshold voltage		2.5 V	0.75		1.5	0.75		1.5	V
		3.3 V	0.99		2.07	0.99		2.07	
		5 V	1.5		3.05	1.5		3.05	
ΔV _T Hysteresis (V _{T+} - V _{T-})		2.5 V	0.25		1	0.25		1	V
		3.3 V	0.33		1.32	0.33		1.32	
		5 V	0.5		2	0.5		2	
V _{OH}	I _{OH} = -50 μA	2 V to 5.5 V	V _{CC} - 0.1			V _{CC} - 0.1			V
	I _{OH} = -2 mA	2.3 V	2			2			
	I _{OH} = -6 mA	3 V	2.48			2.48			
	I _{OH} = -12 mA	4.5 V	3.8			3.8			
V _{OL}	I _{OL} = 50 μA	2 V to 5.5 V	0.1			0.1			V
	I _{OL} = 2 mA	2.3 V	0.4			0.4			
	I _{OL} = 6 mA	3 V	0.44			0.44			
	I _{OL} = 12 mA	4.5 V	0.55			0.55			
I _I	V _I = 5.5 V or GND	0 to 5.5 V	±1			±1			μA
I _{CC}	V _I = V _{CC} or GND, I _O = 0	5.5 V	20			20			μA
I _{off}	V _I or V _O = 0 to 5.5 V	0 V	5			5			μA
C _i	V _I = V _{CC} or GND	3.3 V	1.9			1.9			pF

(1) Product Preview

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54LV132A ⁽¹⁾		SN74LV132A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	Y	$C_L = 15\text{ pF}$	7.9 ⁽²⁾	16.5 ⁽²⁾		1 ⁽²⁾	18.5 ⁽²⁾	1	18.5	ns
			$C_L = 50\text{ pF}$	10.8	20.2		1	23	1	23	

- (1) Product Preview
 (2) On products compliant to MIL-PRF-38535, this parameter is not production tested.

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54LV132A ⁽¹⁾		SN74LV132A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	Y	$C_L = 15\text{ pF}$		5.6 ⁽²⁾	11.9 ⁽²⁾	1 ⁽²⁾	14 ⁽²⁾	1	14	ns
			$C_L = 50\text{ pF}$		7.6	15.4	1	17.5	1	17.5	

- (1) Product Preview
 (2) On products compliant to MIL-PRF-38535, this parameter is not production tested.

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54LV132A ⁽¹⁾		SN74LV132A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	Y	$C_L = 15\text{ pF}$		3.9 ⁽²⁾	7.7 ⁽²⁾	1 ⁽²⁾	9 ⁽²⁾	1	9	ns
			$C_L = 50\text{ pF}$		5.3	9.7	1	11	1	11	

- (1) Product Preview
 (2) On products compliant to MIL-PRF-38535, this parameter is not production tested.

NOISE CHARACTERISTICS⁽¹⁾

$V_{CC} = 3.3\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$

PARAMETER		SN74LV132A			UNIT
		MIN	TYP	MAX	
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		0.21	0.8	V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}		-0.09	-0.8	V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		3.12		V
$V_{IH(D)}$	High-level dynamic input voltage		2.31		V
$V_{IL(D)}$	Low-level dynamic input voltage			0.99	V

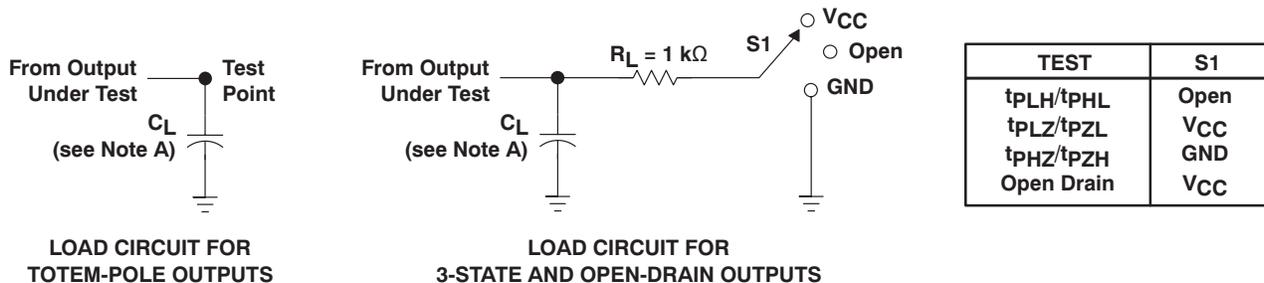
- (1) Characteristics are for surface-mount packages only.

OPERATING CHARACTERISTICS

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

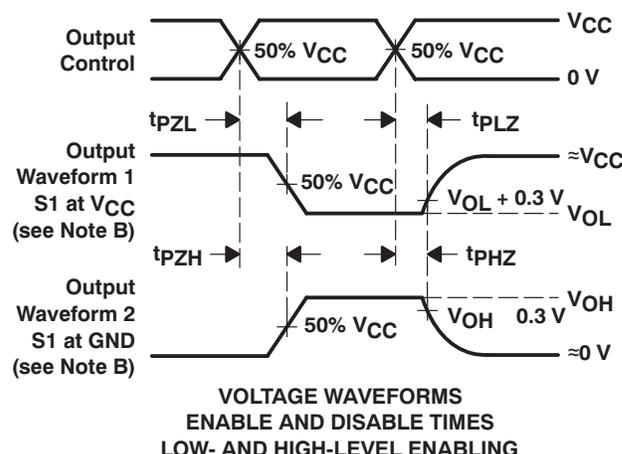
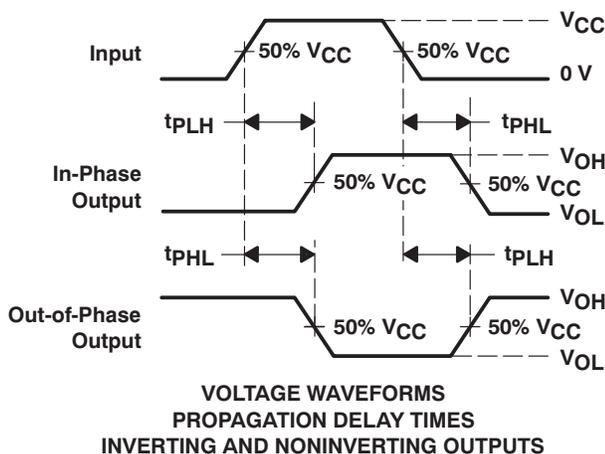
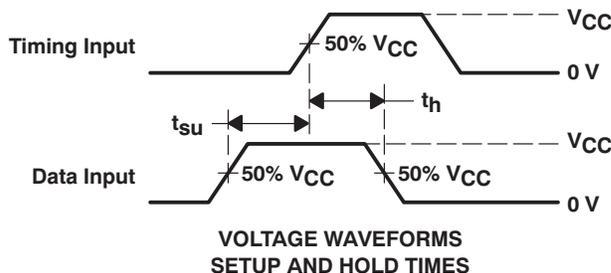
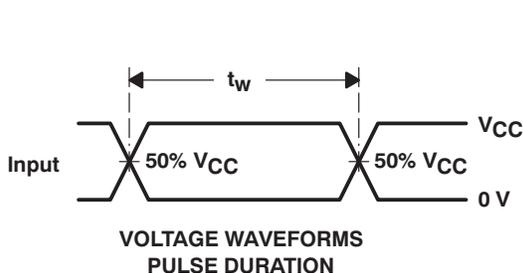
PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance	$C_L = 50\text{ pF}$, $f = 10\text{ MHz}$	3.3 V	7.5	pF
			5 V	11.2	

PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT FOR TOTEM-POLE OUTPUTS

LOAD CIRCUIT FOR 3-STATE AND OPEN-DRAIN OUTPUTS



- 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 ≤ 1 MHz, Z_O = 50 Ω, t_r ≤ 3 ns, t_f ≤ 3 ns.
 - D. The outputs are measured one at a time, with one input transition per measurement.
 - E. t_{PZL} and t_{PHZ} are the same as t_{dis}.
 - F. t_{PZL} and t_{PZH} are the same as t_{en}.
 - G. t_{PHL} and t_{PLH} are the same as t_{pd}.
 - H. All parameters and waveforms are not applicable to all devices.

Figure 1. 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)	Op Temp (°C)	Top-Side Markings (4)	Samples
SN74LV132AD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADBRE4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADBRG4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADGVR	ACTIVE	TVSOP	DGV	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADGVRE4	ACTIVE	TVSOP	DGV	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADGVRG4	ACTIVE	TVSOP	DGV	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ADRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132ANSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	74LV132A	Samples
SN74LV132ANSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	74LV132A	Samples
SN74LV132ANSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	74LV132A	Samples
SN74LV132APW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132APWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
SN74LV132APWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132APWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132APWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132APWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132APWT	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132APWTE4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples
SN74LV132APWTG4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV132A	Samples

(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.

OBSELETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

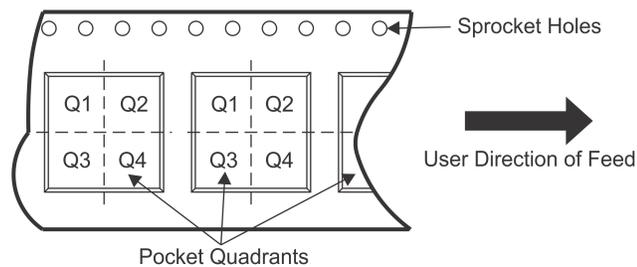
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TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74LV132ADBR	SSOP	DB	14	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN74LV132ADGVR	TVSOP	DGV	14	2000	330.0	12.4	6.8	4.0	1.6	8.0	12.0	Q1
SN74LV132ADR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74LV132ANSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN74LV132APWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV132APWT	TSSOP	PW	14	250	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

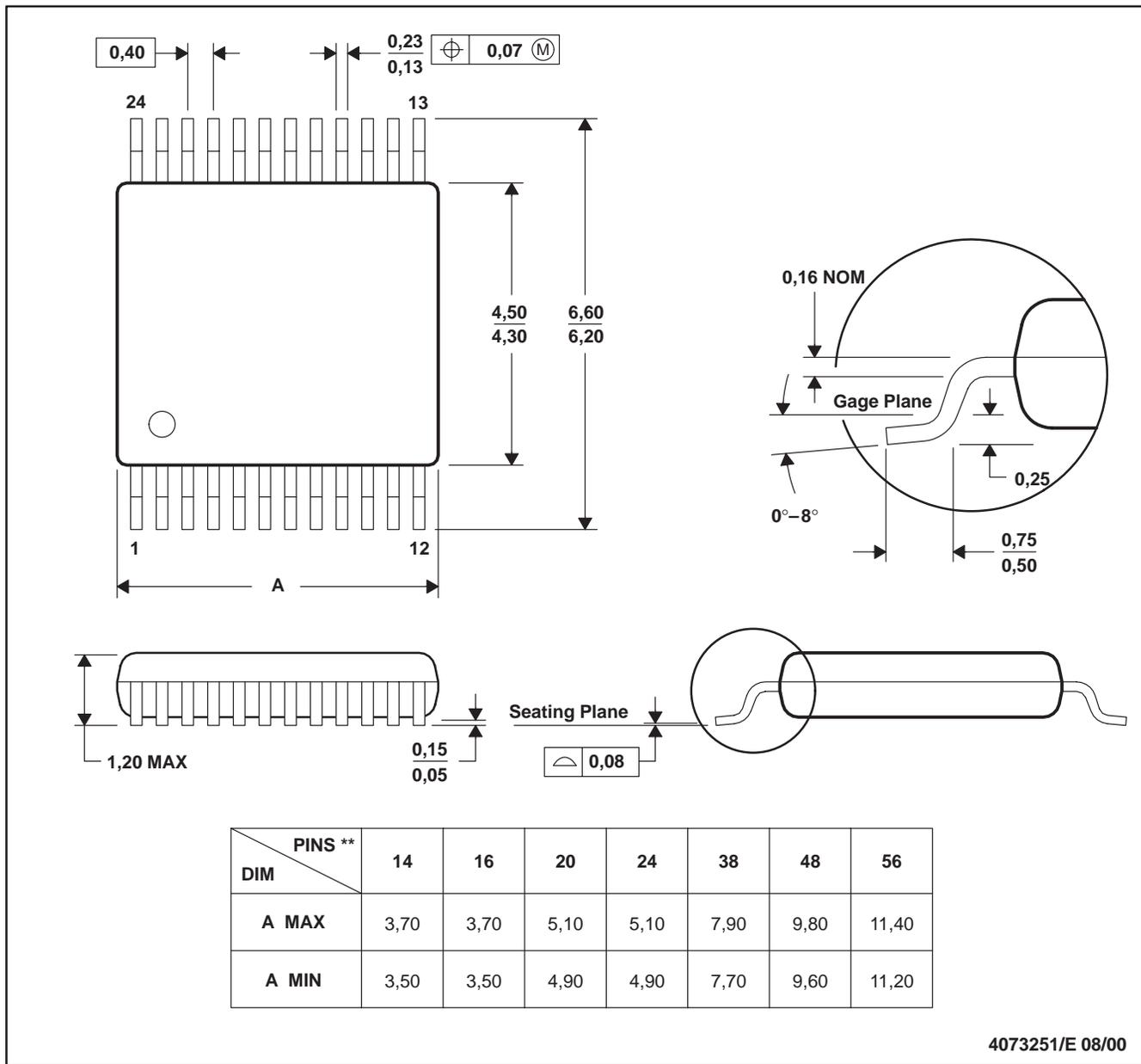

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LV132ADBR	SSOP	DB	14	2000	367.0	367.0	38.0
SN74LV132ADGVR	TVSOP	DGV	14	2000	367.0	367.0	35.0
SN74LV132ADR	SOIC	D	14	2500	367.0	367.0	38.0
SN74LV132ANSR	SO	NS	14	2000	367.0	367.0	38.0
SN74LV132APWR	TSSOP	PW	14	2000	367.0	367.0	35.0
SN74LV132APWT	TSSOP	PW	14	250	367.0	367.0	35.0

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

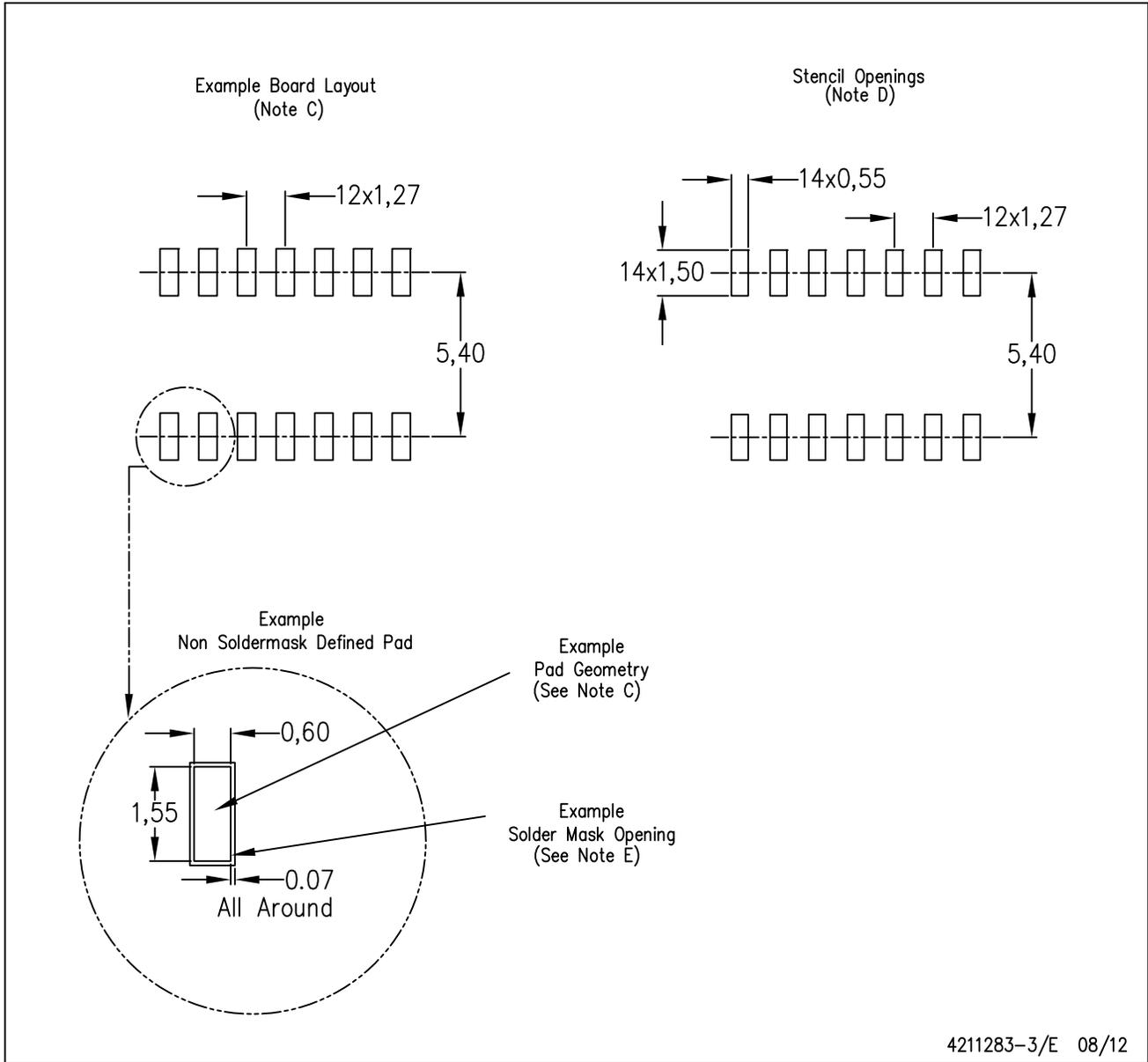
24 PINS SHOWN



- 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

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE

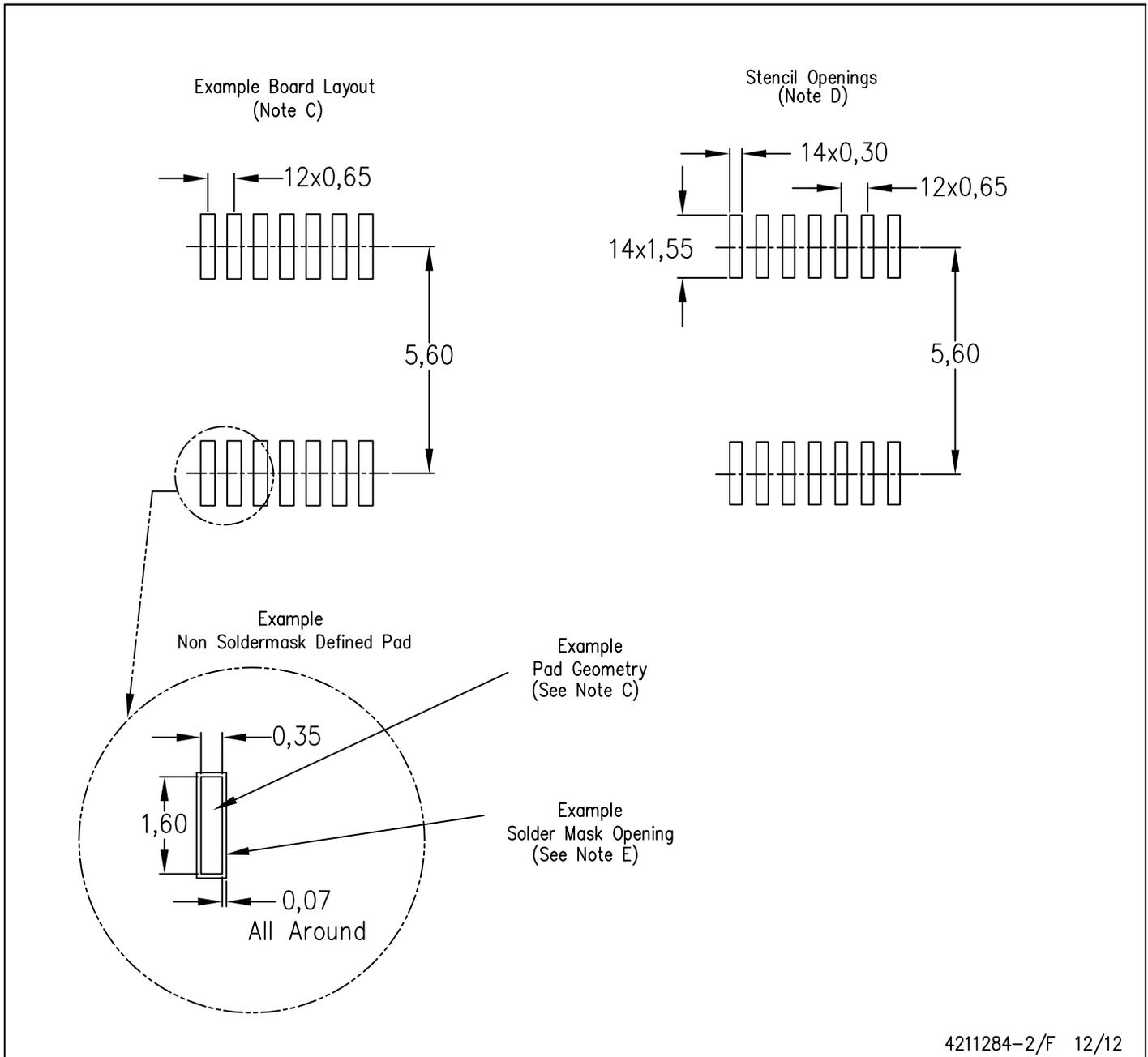


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- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



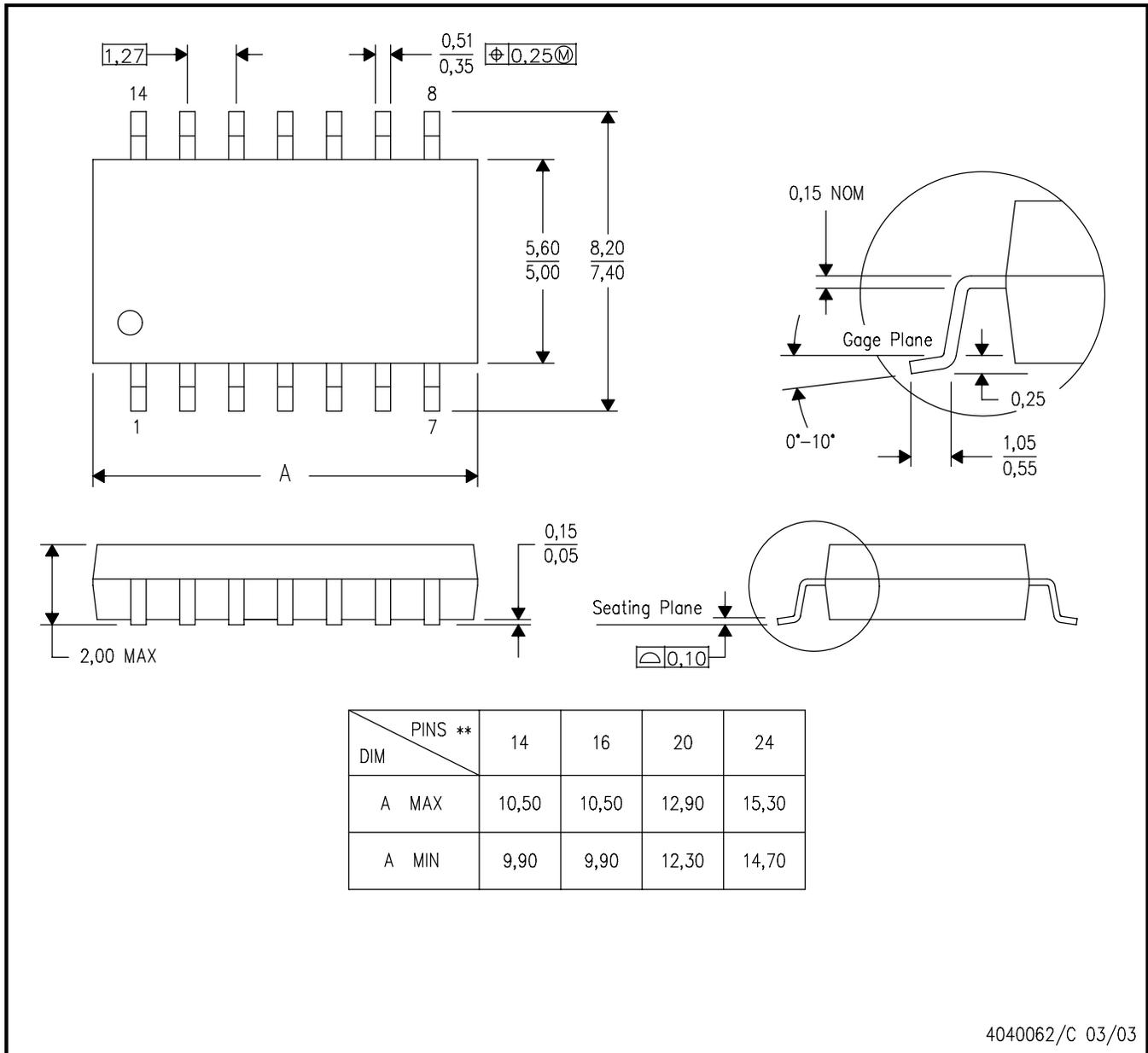
- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

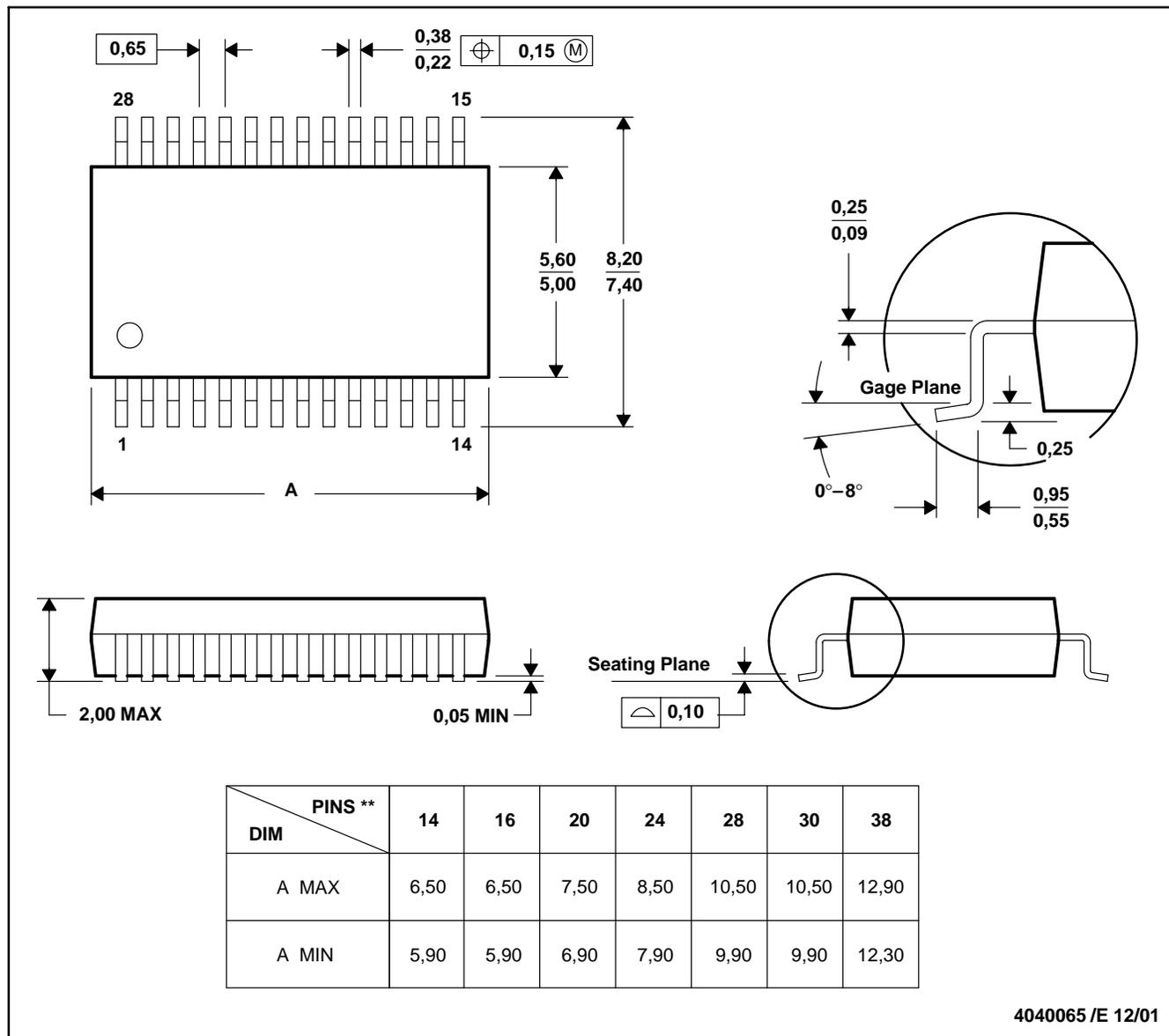


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 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.
 D. Falls within JEDEC MO-150

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