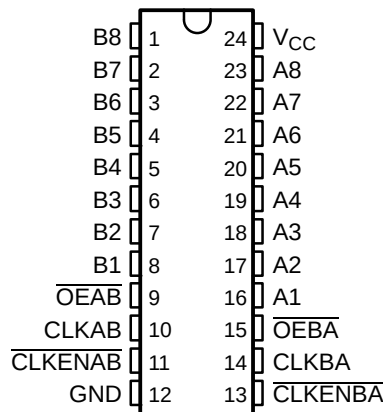


FEATURES

- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max t_{pd} of 8.2 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)
 - 1000-V Charged-Device Model (C101)

DB, DW, NS, OR PW PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

This octal bus transceiver and register is designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74LVC2952A consists of two 8-bit back-to-back registers that store data flowing in both directions between two bidirectional buses. Data on the A or B bus is stored in the registers on the low-to-high transition of the clock (CLKAB or CLKBA) input, provided that the clock-enable ($\overline{CLKENAB}$ or $\overline{CLKENBA}$) input is low. Taking the output-enable ($\overline{OEAB}$ or $\overline{OEBA}$) input low accesses the data on either port.

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

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.

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.

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SOIC – DW	Tube of 25	SN74LVC2952ADW	LVC2952A
		Reel of 2000	SN74LVC2952ADWR	
	SOP – NS	Reel of 2000	SN74LVC2952ANSR	LVC2952A
	SSOP – DB	Reel of 2000	SN74LVC2952ADBR	LE952A
	TSSOP – PW	Tube of 60	SN74LVC2952APW	LE952A
		Reel of 2000	SN74LVC2952APWR	
		Reel of 250	SN74LVC2952APWT	

(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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- (1) A-to-B data flow is shown; B-to-A data flow is similar, but uses $\overline{\text{CLKENBA}}$, CLKBA , and $\overline{\text{OEBA}}$.
- (2) Level of B before the indicated steady-state input conditions were established

The diagram illustrates a 16-channel multiplexer circuit. It consists of two 4-to-1 multiplexers, labeled C1 1D. The first multiplexer selects between inputs A1 (16) and B1 (8) based on control signals. The control signals are derived from CLKENAB (11), CLKAB (10), OEAB (9), CLKENBA (13), and CLKBA (14). The outputs of the multiplexers are connected to a bus labeled "To Seven Other Channels".

Absolute Maximum Ratings⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	−0.5	6.5	V
V_I	Input voltage range ⁽²⁾	−0.5	6.5	V
V_O	Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾	−0.5	6.5	V
V_O	Voltage range applied to any output in the high or low state ⁽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 V_{CC} or GND			±100 mA
θ_{JA}	Package thermal impedance ⁽⁴⁾	DB package		63
		DW package		46
		NS package		65
		PW package		88
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) The value of V_{CC} is provided in the recommended operating conditions table.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾

		MIN	MAX	UNIT
V_{CC}	Supply voltage	Operating	1.65	3.6
		Data retention only	1.5	
V_{IH}	High-level input voltage	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.65 \times V_{CC}$	
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2	
V_{IL}	Low-level input voltage	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.35 \times V_{CC}$	
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0.7	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	0.8	
V_I	Input voltage	0	5.5	V
V_O	Output voltage	High or low state	0	V_{CC}
		3-state	0	5.5
I_{OH}	High-level output current	$V_{CC} = 1.65 \text{ V}$	−4	
		$V_{CC} = 2.3 \text{ V}$	−8	
		$V_{CC} = 2.7 \text{ V}$	−12	
		$V_{CC} = 3 \text{ V}$	−24	
I_{OL}	Low-level output current	$V_{CC} = 1.65 \text{ V}$	4	
		$V_{CC} = 2.3 \text{ V}$	8	
		$V_{CC} = 2.7 \text{ V}$	12	
		$V_{CC} = 3 \text{ V}$	24	
$\Delta t/\Delta v$	Input transition rise or fall rate		10	ns/V
T_A	Operating free-air temperature	−40	85	°C

- (1) 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.

SN74LVC2952A

OCTAL BUS TRANSCEIVER AND REGISTER WITH 3-STATE OUTPUTS

SCAS311I—JANUARY 1993—REVISED MARCH 2005



Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	V _{CC}	MIN	TYP ⁽¹⁾	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} ⁽²⁾		V _O = 0 to 5.5 V	3.6 V			±10	µA
I _{CC}		V _I = V _{CC} or GND	3.6 V			10	µA
		3.6 V ≤ V _I ≤ 5.5 V ⁽³⁾				10	
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			8.5	pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

(2) For I/O ports, the parameter I_{OZ} includes the input leakage current.

(3) This applies in the disabled state only.

Timing Requirements

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

			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	
f _{clock}	Clock frequency		(1)		(1)		150		150		MHz
t _w	Pulse duration, CLK high or low		(1)		(1)		3.3		3.3		ns
t _{su}	Setup time	Data before CLK high	(1)		(1)		1.7		1.3		ns
		CLKEN before CLK high	(1)		(1)		1.3		1.1		
t _h	Hold time	Data after CLK high	(1)		(1)		1.8		1.1		ns
		CLKEN after CLK high	(1)		(1)		1.4		1.1		

(1) This information was not available at the time of publication.

Switching Characteristics

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$		$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\max}$			(1)		(1)		150		150		MHz
t_{pd}	CLKAB or CLKBA	B or A	(1)	(1)	(1)	(1)	8.8		1	8.2	ns
t_{en}	$\overline{OE}$	A or B	(1)	(1)	(1)	(1)	9		1	7.8	ns
t_{dis}	$\overline{OE}$	A or B	(1)	(1)	(1)	(1)	8.8		1	7.8	ns
$t_{sk(o)}$									1		ns

(1) This information was not available at the time of publication.

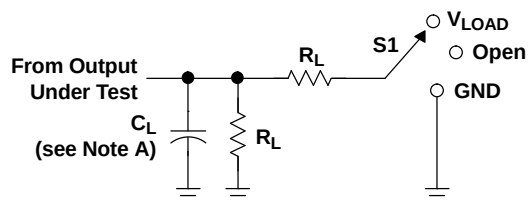
Operating Characteristics

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

PARAMETER			TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
				TYP	TYP	TYP	
C_{pd}	Power dissipation capacitance per transceiver	Outputs enabled	$f = 10\text{ MHz}$	(1)	(1)	79	pF
		Outputs disabled		(1)	(1)	41	

(1) This information was not available at the time of publication.

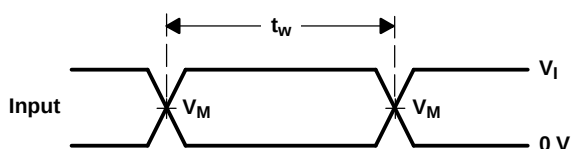
PARAMETER MEASUREMENT INFORMATION



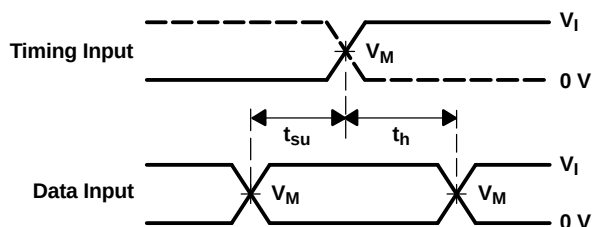
LOAD CIRCUIT

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

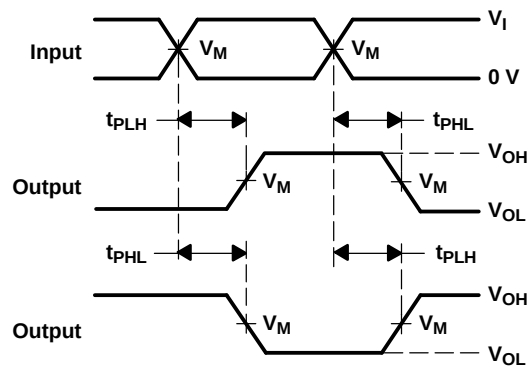
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_{Δ}
	V_I	t_r/t_f					
$1.8\text{ V} \pm 0.15\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k Ω	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	$\leq 2.5\text{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



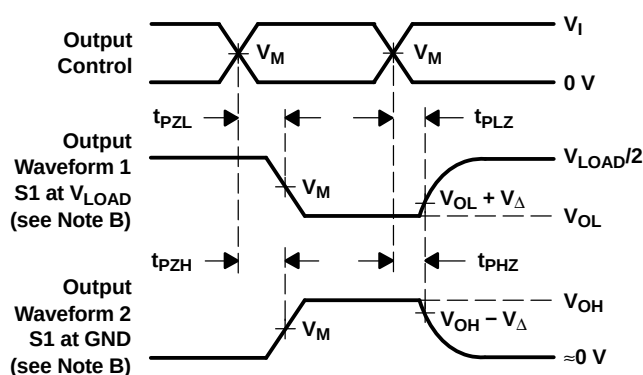
VOLTAGE WAVEFORMS
PULSE DURATION



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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LVC2952ADBR	ACTIVE	SSOP	DB	24	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LE952A	Samples
SN74LVC2952APWR	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LE952A	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.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

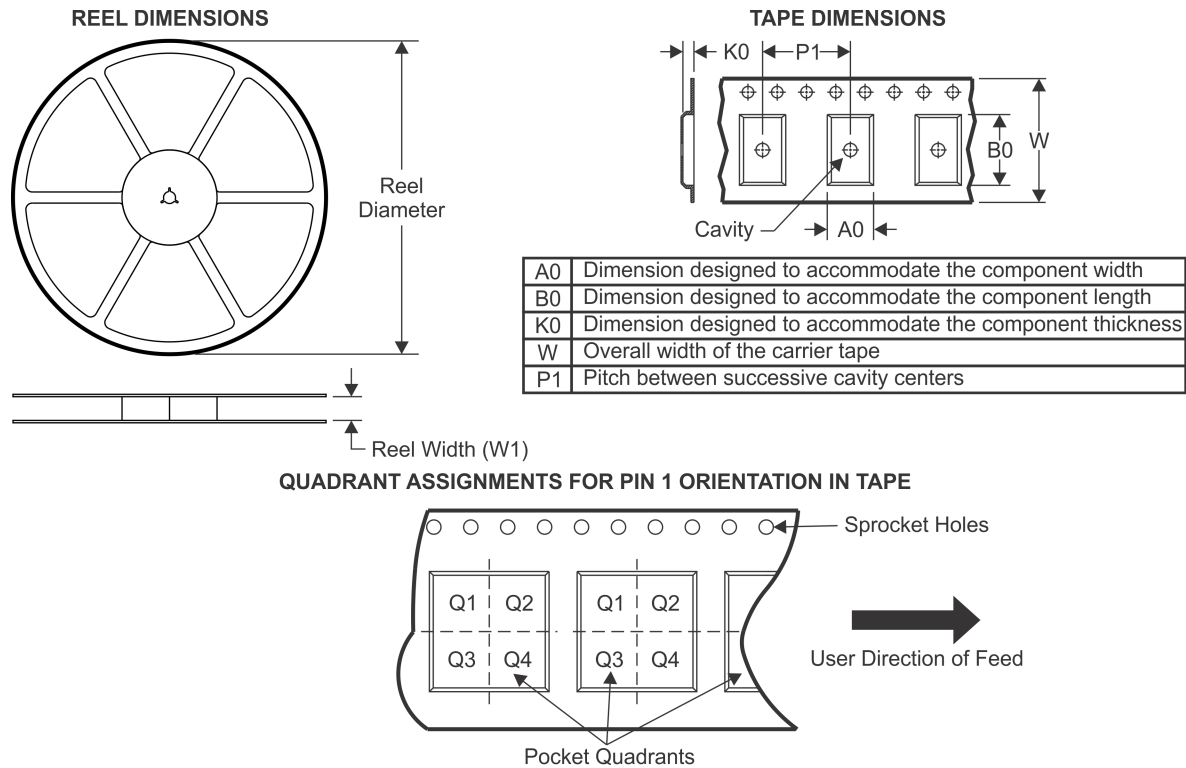
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

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

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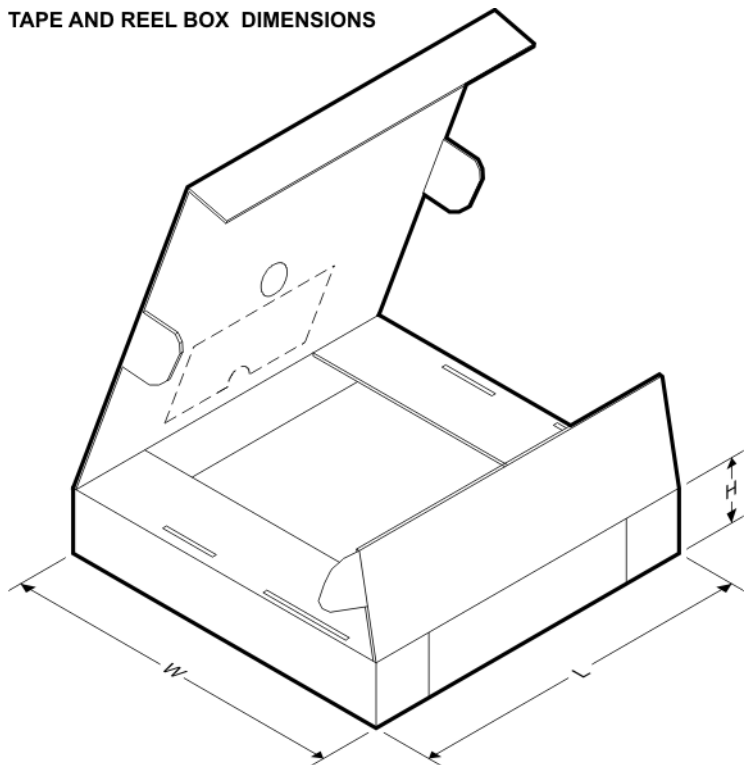
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TAPE AND REEL INFORMATION


*All dimensions are nominal

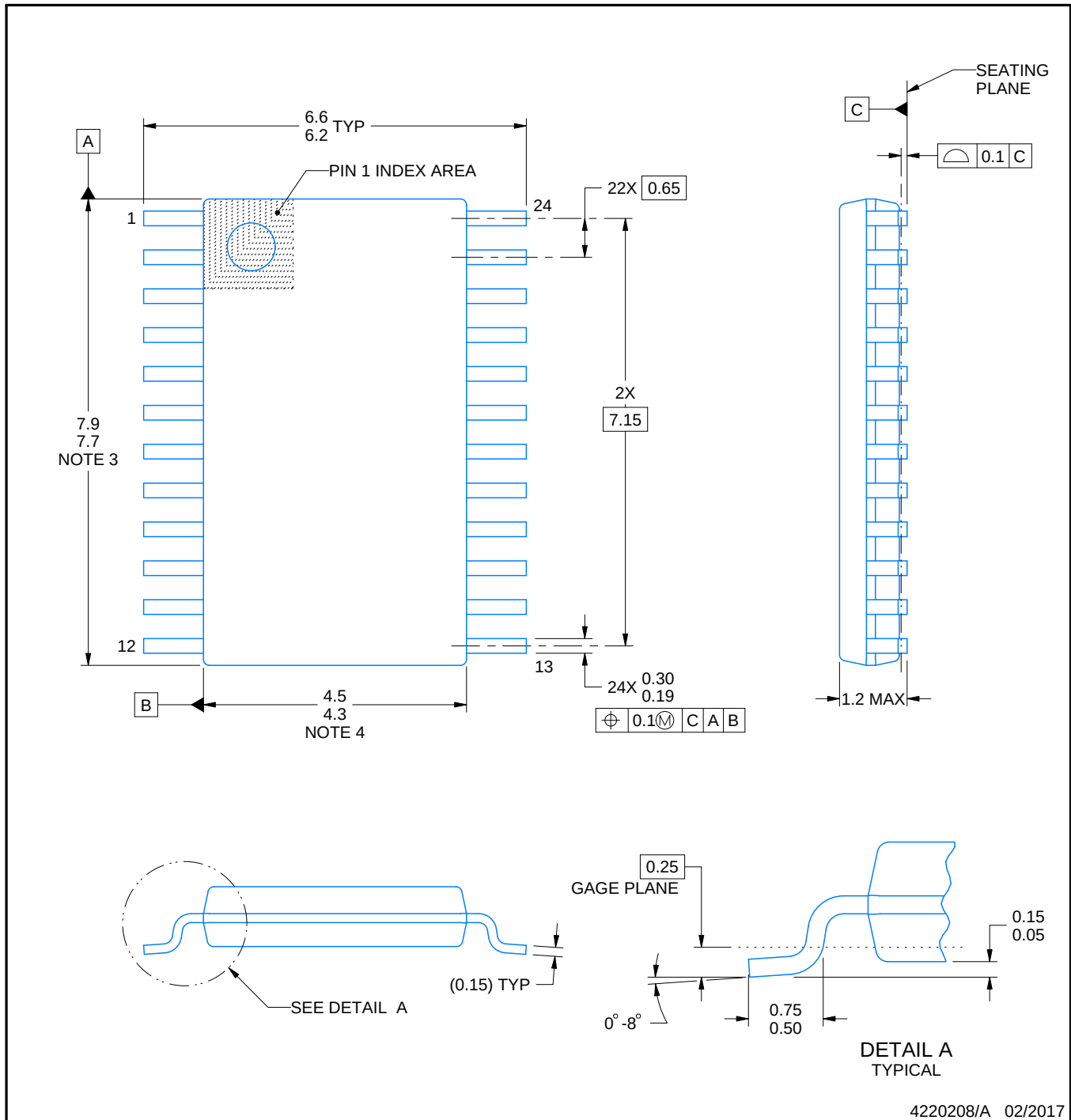
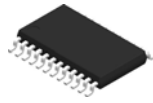
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LVC2952ADBR	SSOP	DB	24	2000	330.0	16.4	8.2	8.8	2.5	12.0	16.0	Q1
SN74LVC2952APWR	TSSOP	PW	24	2000	330.0	16.4	6.95	8.3	1.6	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC2952ADBR	SSOP	DB	24	2000	367.0	367.0	38.0
SN74LVC2952APWR	TSSOP	PW	24	2000	367.0	367.0	38.0



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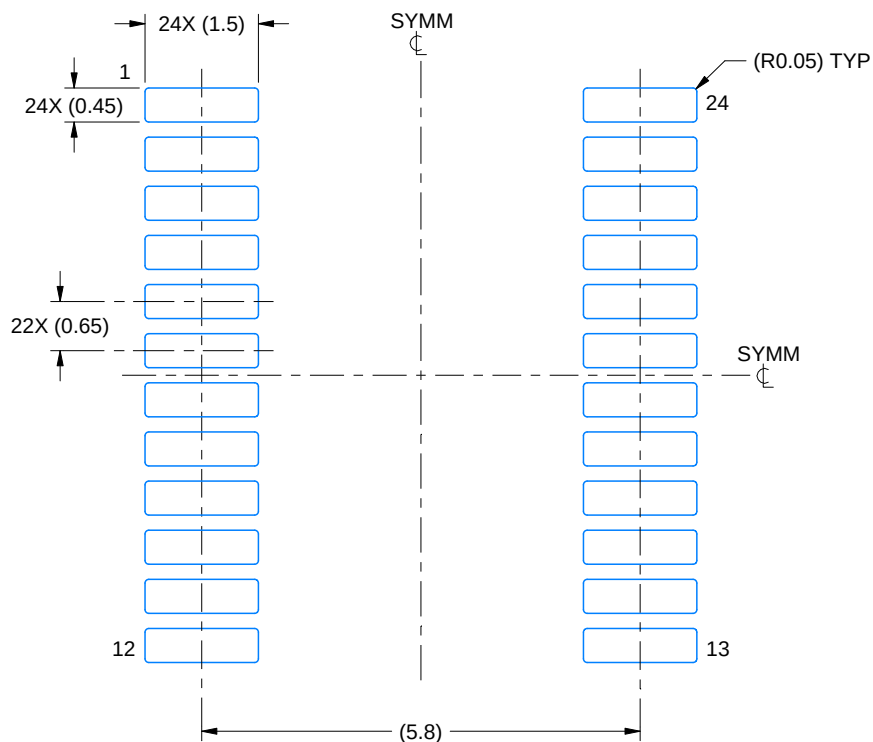
NOTES:

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. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

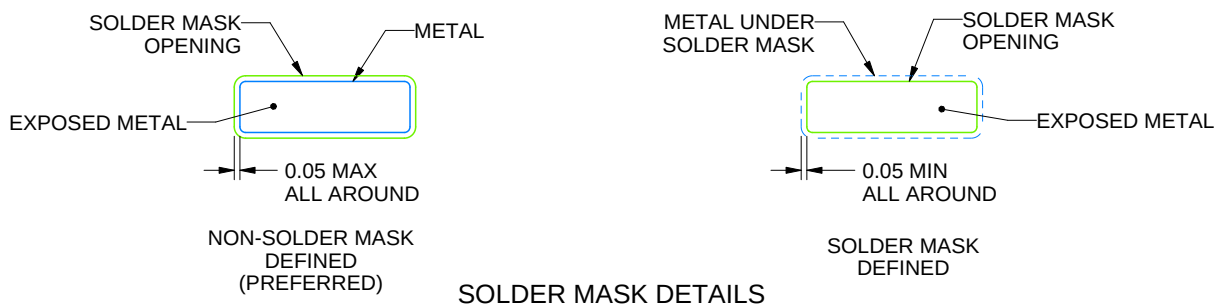
PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220208/A 02/2017

NOTES: (continued)

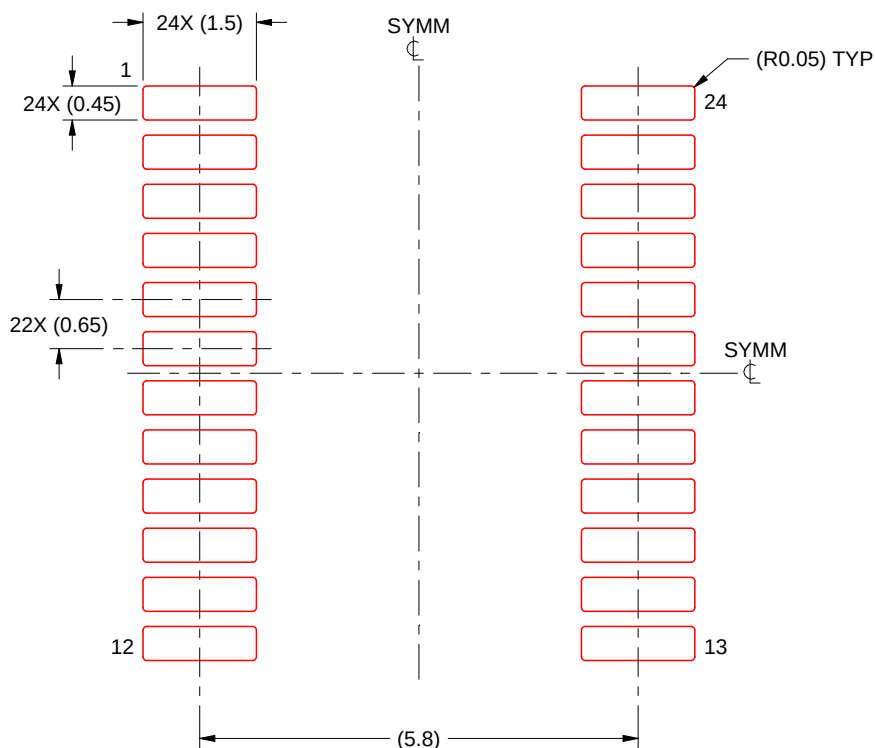
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220208/A 02/2017

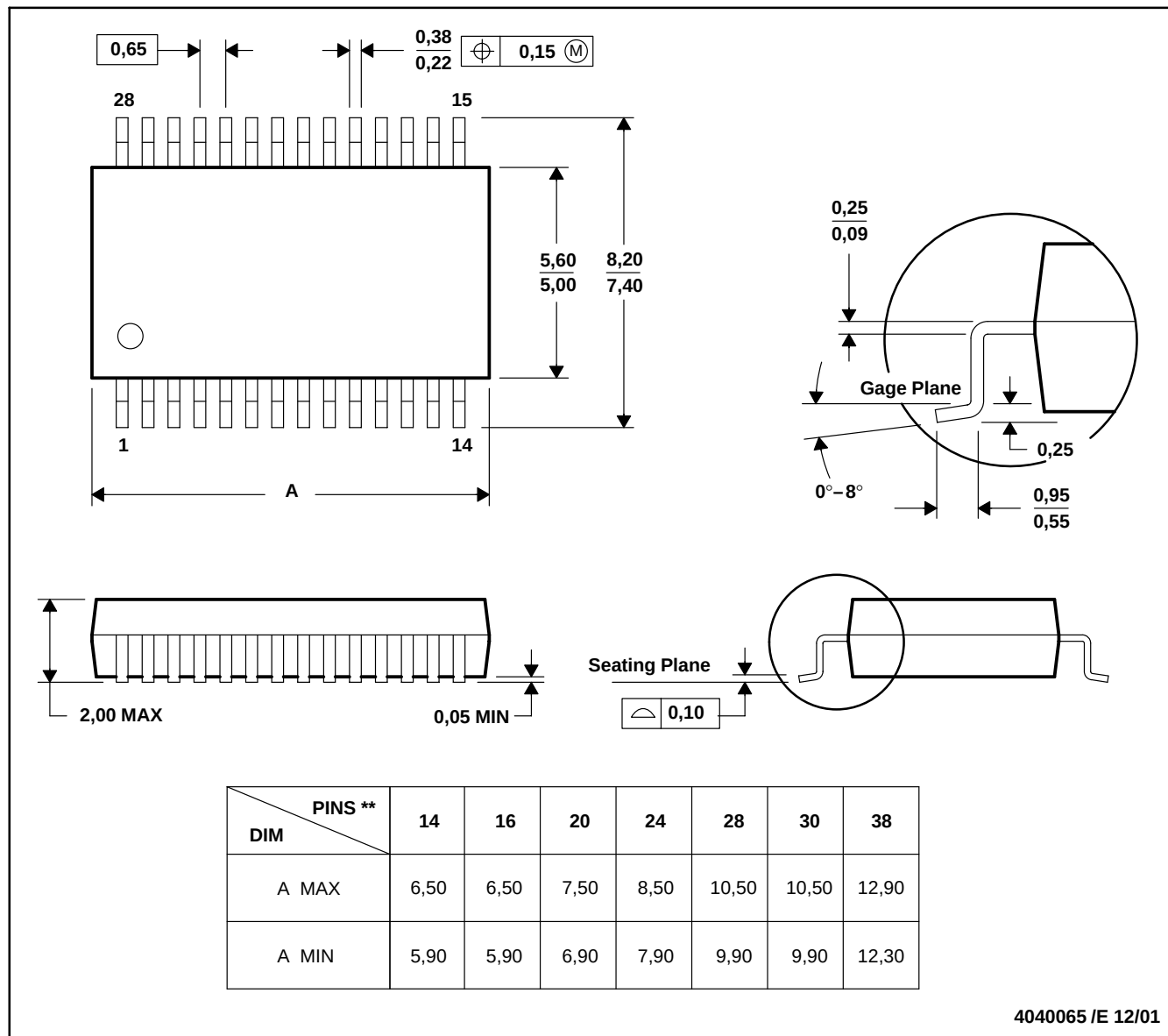
NOTES: (continued)

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

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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