

SN54LVTZ245, SN74LVTZ245 3.3-V ABT OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS303C – DECEMBER 1993 – REVISED JANUARY 1996

- State-of-the-Art Advanced BiCMOS Technology (ABT) Design for 3.3-V Operation and Low-Static Power Dissipation
- High-Impedance State During Power Up and Power Down
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V V_{CC})
- Support Unregulated Battery Operation Down to 2.7 V
- Typical V_{OLP} (Output Ground Bounce) < 0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Bus-Hold Data Inputs Eliminate the Need for External Pullup/Pulldown Resistors
- Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Chip Carriers (FK), and Ceramic (J) DIPs

description

These octal bus transceivers are designed specifically for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment.

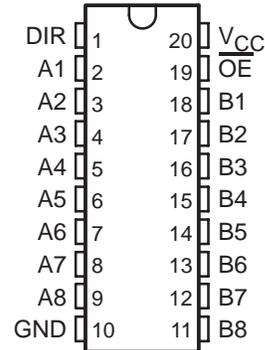
These devices are designed for asynchronous communication between data buses. They transmit data from the A bus to the B bus or from the B bus to the A bus, depending upon the logic level at the direction-control (DIR) input. The output-enable (\overline{OE}) input can be used to disable the devices so the buses are effectively isolated.

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

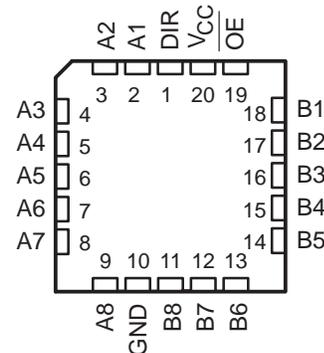
The SN74LVTZ245 is available in TI's shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54LVTZ245 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LVTZ245 is characterized for operation from -40°C to 85°C .

SN54LVTZ245 . . . J PACKAGE
SN74LVTZ245 . . . DB, DW, OR PW PACKAGE
(TOP VIEW)



SN54LVTZ245 . . . FK PACKAGE
(TOP VIEW)



FUNCTION TABLE

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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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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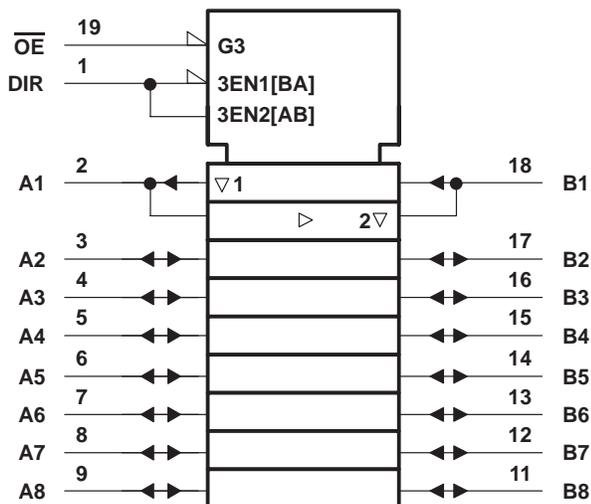
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SN54LVTZ245, SN74LVTZ245

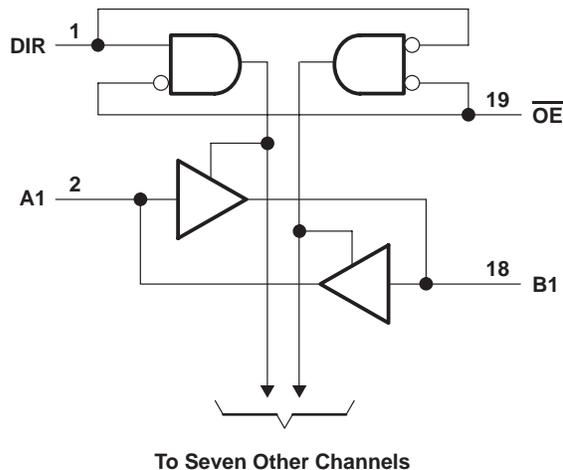
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logic symbol†



logic diagram (positive logic)



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the DB, DW, PW, and J packages.

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 (see Note 1)	-0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, V_O (see Note 1)	-0.5 V to 7 V
Current into any output in the low state, I_O : SN54LVTZ245	96 mA
SN74LVTZ245	128 mA
Current into any output in the high state, I_O (see Note 2): SN54LVTZ245	48 mA
SN74LVTZ245	64 mA
Input clamp current, I_{IK} ($V_I < 0$)	-50 mA
Output clamp current, I_{OK} ($V_O < 0$)	-50 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DB package	0.6 W
DW package	1.6 W
PW package	0.7 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 current flows only when the output is in the high state and $V_O > V_{CC}$.
 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.



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recommended operating conditions (see Note 4)

		SN54LVTZ245		SN74LVTZ245		UNIT
		MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	2.7	3.6	2.7	3.6	V
V_{IH}	High-level input voltage	2		2		V
V_{IL}	Low-level input voltage		0.8		0.8	V
V_I	Input voltage		5.5		5.5	V
I_{OH}	High-level output current		-24		-32	mA
I_{OL}	Low-level output current		48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10	10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200		200		μ s/V
T_A	Operating free-air temperature	-55	125	-40	85	$^{\circ}$ C

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



SN54LVTZ245, SN74LVTZ245

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

PARAMETER	TEST CONDITIONS		SN54LVTZ245		SN74LVTZ245		UNIT	
			MIN	TYP†	MAX	MIN		TYP†
V_{IK}	$V_{CC} = 2.7\text{ V}$, $I_I = -18\text{ mA}$		-1.2		-1.2		V	
V_{OH}	$V_{CC} = \text{MIN to MAX}‡$, $I_{OH} = -100\text{ }\mu\text{A}$		$V_{CC}-0.2$		$V_{CC}-0.2$		V	
	$V_{CC} = 2.7\text{ V}$, $I_{OH} = -8\text{ mA}$		2.4		2.4			
	$V_{CC} = 3\text{ V}$	$I_{OH} = -24\text{ mA}$ $I_{OH} = -32\text{ mA}$	2		2			
V_{OL}	$V_{CC} = 2.7\text{ V}$	$I_{OL} = 100\text{ }\mu\text{A}$	0.2		0.2		V	
		$I_{OL} = 24\text{ mA}$	0.5		0.5			
	$V_{CC} = 3\text{ V}$	$I_{OL} = 16\text{ mA}$	0.4		0.4			
		$I_{OL} = 32\text{ mA}$	0.5		0.5			
		$I_{OL} = 48\text{ mA}$	0.55		0.55			
		$I_{OL} = 64\text{ mA}$			0.55			
I_I	$V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}$ or GND	Control inputs	± 1		± 1		μA	
	$V_{CC} = 0$ or $\text{MAX}‡$, $V_I = 5.5\text{ V}$		10		10			
	$V_{CC} = 3.6\text{ V}$	$V_I = 5.5\text{ V}$	100		20			
		$V_I = V_{CC}$ $V_I = 0$	A or B ports§	5		5		
		-10		-10				
I_{off}	$V_{CC} = 0$, V_I or $V_O = 0$ to 4.5 V				± 100		μA	
$I_{OZPU}¶$	$V_{CC} = 0$ to 1.5 V , $V_O = 0.5\text{ V}$ to 3 V , $\overline{OE} = X$				± 50		μA	
$I_{OZPD}¶$	$V_{CC} = 1.5\text{ V}$ to 0 , $V_O = 0.5\text{ V}$ to 3 V , $\overline{OE} = X$				± 50		μA	
$I_I(\text{hold})$	$V_{CC} = 3\text{ V}$	$V_I = 0.8\text{ V}$	75		75		μA	
		$V_I = 2\text{ V}$	-75		-75			
I_{OZH}	$V_{CC} = 3.6\text{ V}$, $V_O = 3\text{ V}$		1		1		μA	
I_{OZL}	$V_{CC} = 3.6\text{ V}$, $V_O = 0.5\text{ V}$		-1		-1		μA	
I_{CC}	$V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}$ or GND	$I_O = 0$,	Outputs high	0.13	0.5	0.13	0.225	mA
			Outputs low	8.8	17	8.8	15	
			Outputs disabled	0.13	0.5	0.13	0.225	
$\Delta I_{CC}\#$	$V_{CC} = 3\text{ V}$ to 3.6 V , One input at $V_{CC} - 0.6\text{ V}$, Other inputs at V_{CC} or GND		0.3		0.2		mA	
C_i	$V_I = 3\text{ V}$ or 0		4		4		pF	
C_{io}	$V_O = 3\text{ V}$ or 0		10		10		pF	

† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

‡ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

§ Unused terminals at V_{CC} or GND

¶ This parameter is specified by characterization but is not production tested.

This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.



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switching characteristics over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTZ245				SN74LVTZ245				UNIT	
			$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$			$V_{CC} = 2.7\text{ V}$		
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN		MAX
t_{PLH}	A or B	B or A	1	4.6	5.3		1	2.5	4	5.2		ns
t_{PHL}			1	4.1	5.7		1	2.5	4	5.5		
t_{PZH}	\overline{OE}	A or B	1.1	6.1	7.2		1.1	3.3	5.9	7.1		ns
t_{PZL}			1.5	6.6	8		1.5	3.8	6.5	7.9		
t_{PHZ}	\overline{OE}	A or B	2.2	6.2	7		2.2	4.3	5.9	6.5		ns
t_{PLZ}			2	5.7	5.9		2	3.9	5.5	5.6		

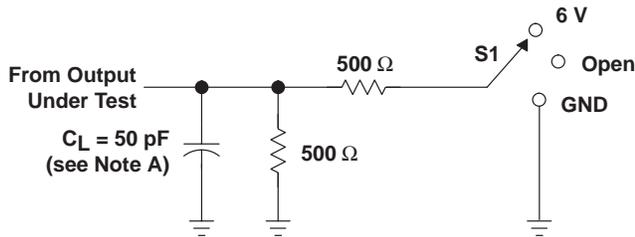
† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.



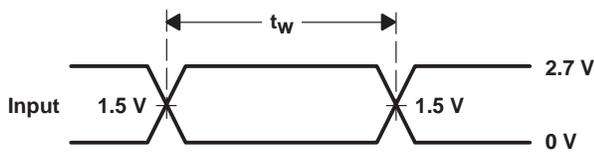
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PARAMETER MEASUREMENT INFORMATION

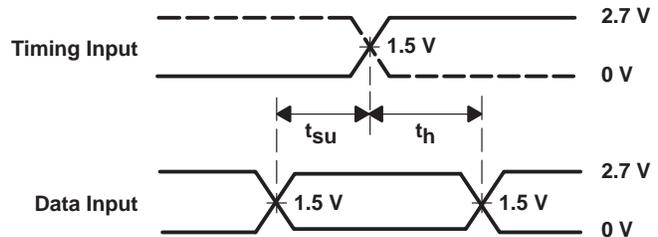


LOAD CIRCUIT FOR OUTPUTS

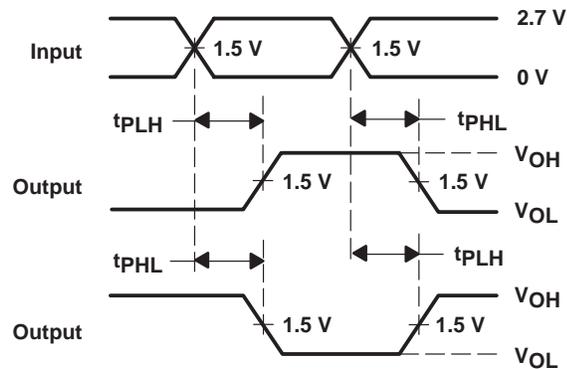


VOLTAGE WAVEFORMS
PULSE DURATION

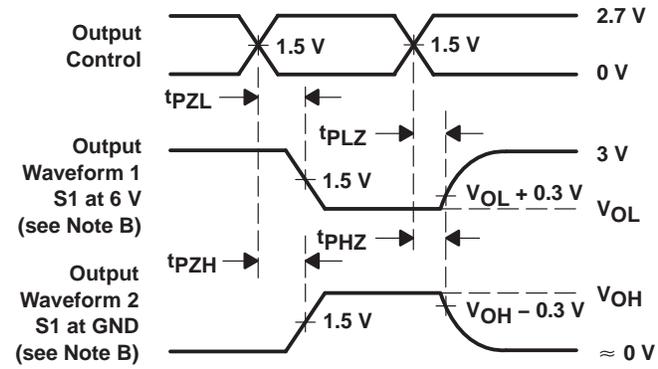
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



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: 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: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$, $t_r \leq 2.5$ ns, $t_f \leq 2.5$ ns.
 D. The outputs are measured one at a time with one transition per measurement.

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
SN74LVTZ245DBLE	OBSOLETE	SSOP	DB	20		TBD	Call TI	Call TI	-40 to 85		
SN74LVTZ245DW	OBSOLETE	SOIC	DW	20		TBD	Call TI	Call TI	-40 to 85		
SN74LVTZ245DWR	OBSOLETE	SOIC	DW	20		TBD	Call TI	Call TI	-40 to 85		
SN74LVTZ245PWLE	OBSOLETE	TSSOP	PW	20		TBD	Call TI	Call TI	-40 to 85		

(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), 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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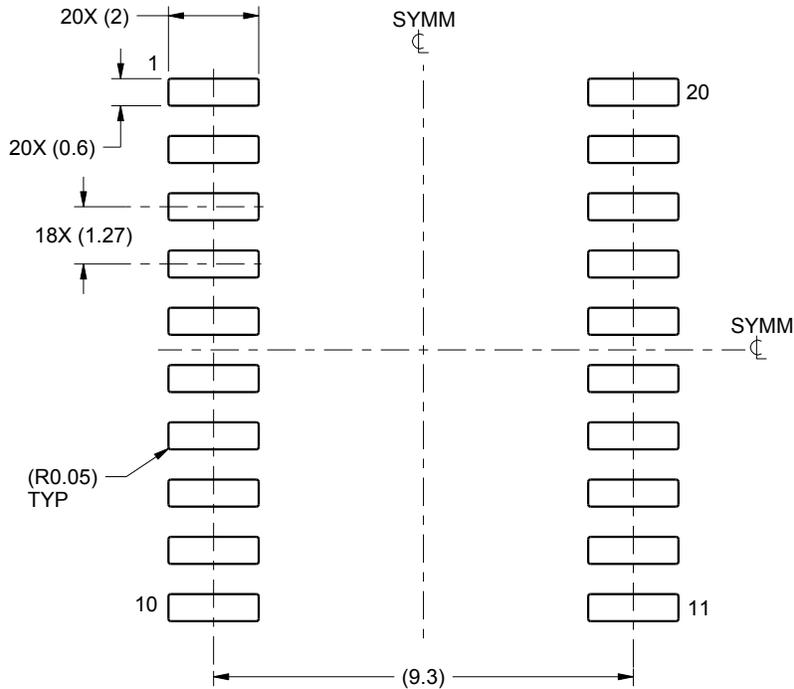
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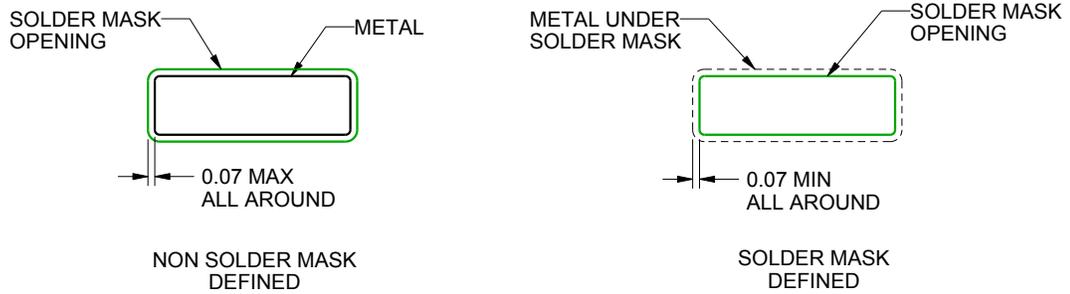
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

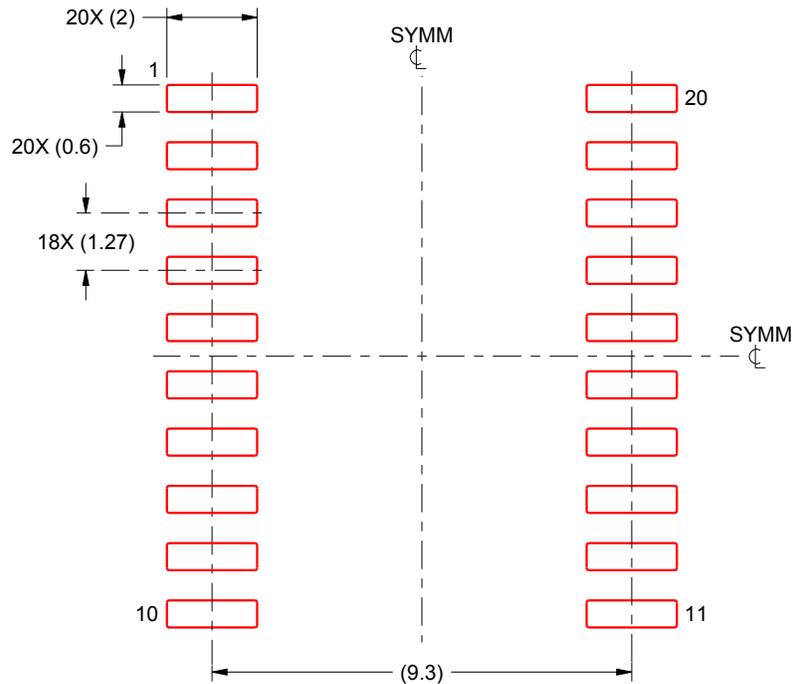
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



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

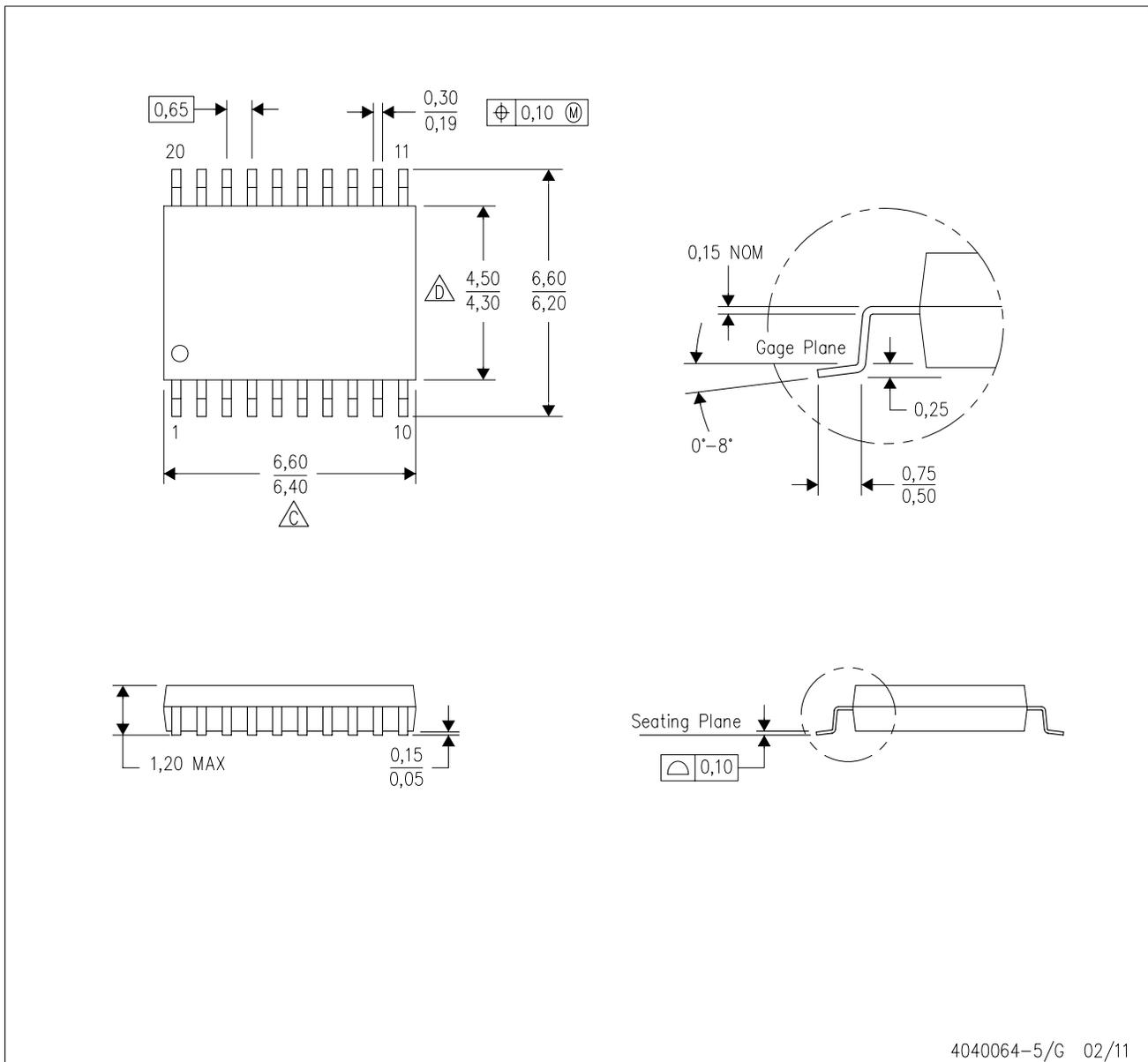
4220724/A 05/2016

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.

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



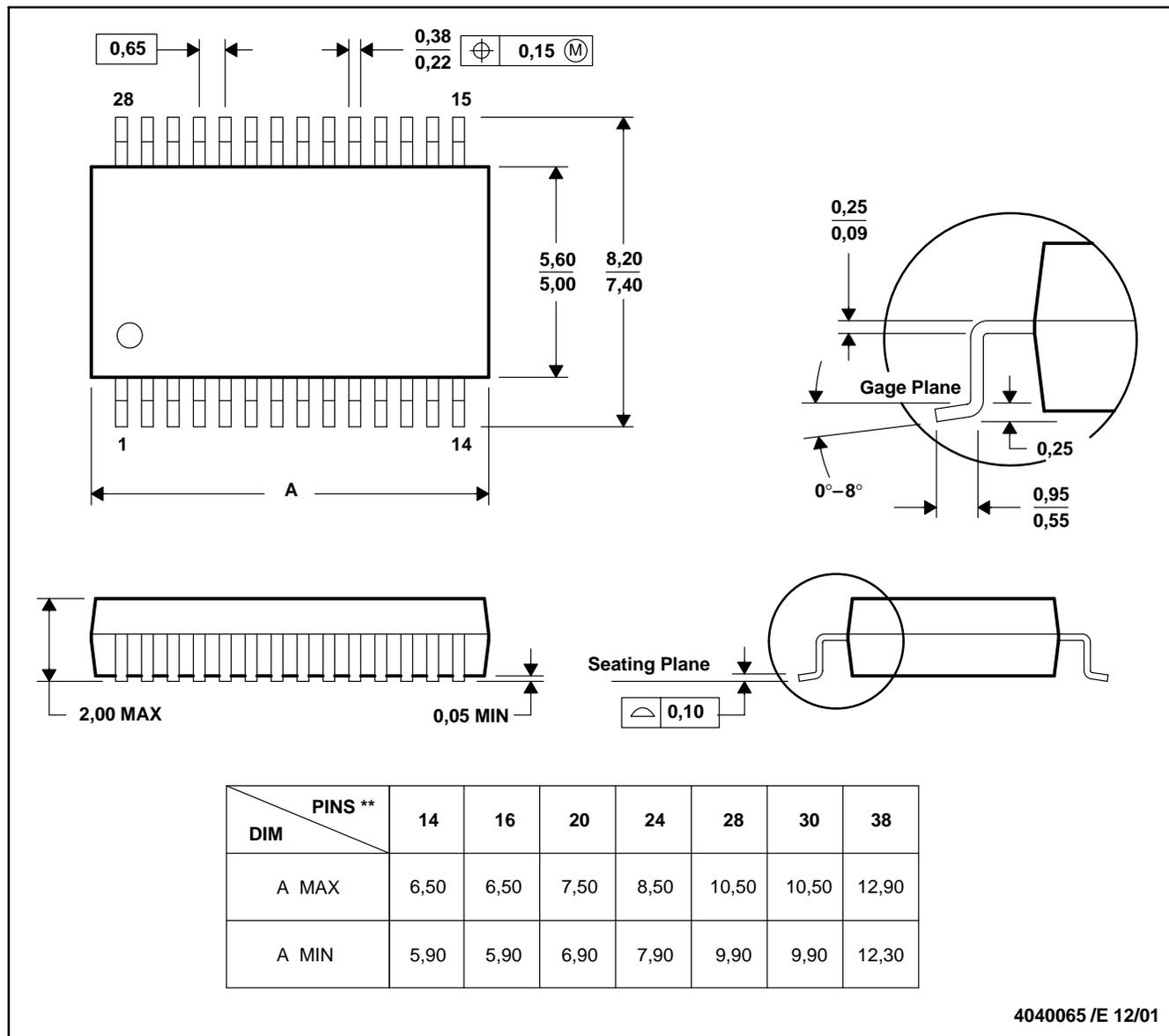
4040064-5/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

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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