

## FEATURES

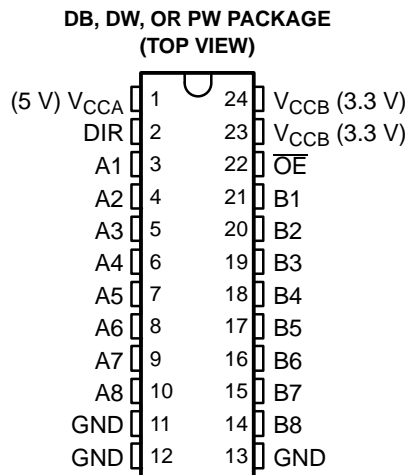
- Bidirectional Voltage Translator
- 5.5 V on A Port and 2.7 V to 3.6 V on B Port
- Control Inputs  $V_{IH}/V_{IL}$  Levels Are Referenced to  $V_{CCA}$  Voltage
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

## DESCRIPTION/ORDERING INFORMATION

This 8-bit (octal) noninverting bus transceiver contains two separate supply rails; B port has  $V_{CCB}$ , which is set at 3.3 V, and A port has  $V_{CCA}$ , which is set at 5 V. This allows for translation from a 3.3-V to a 5-V environment, and vice versa.

The SN74LVC4245A is designed for asynchronous communication between data buses. The device transmits data 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 the buses are effectively isolated. The control circuitry (DIR,  $\overline{OE}$ ) is powered by  $V_{CCA}$ .

The SN74LVC4245A pinout allows the designer to switch to a normal all-3.3-V or all-5-V 20-pin '245 device without board re-layout. The designer uses the data paths for pins 2–11 and 14–23 of the SN74LVC4245A to align with the conventional '245 pinout.



## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SOIC – DW	Tube of 25	SN74LVC4245ADW	LVC4245A
		Reel of 2000	SN74LVC4245ADWR	
	SSOP – DB	Reel of 2000	SN74LVC4245ADBR	LJ245A
	TSSOP – PW	Tube of 60	SN74LVC4245APW	LJ245A
		Reel of 2000	SN74LVC4245APWR	
		Reel of 250	SN74LVC4245APWT	

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE

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

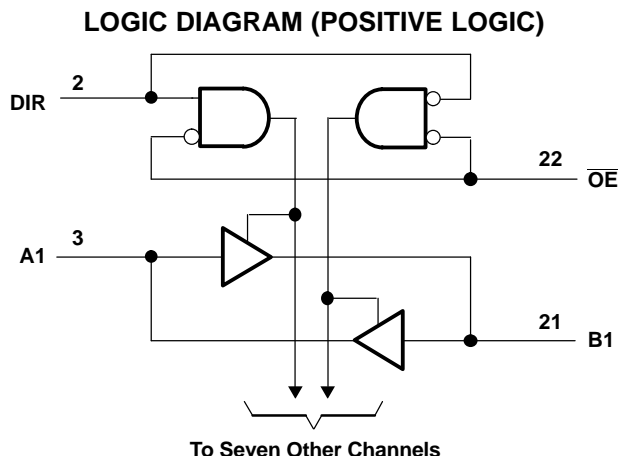


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# SN74LVC4245A

## OCTAL BUS TRANSCEIVER AND 3.3-V TO 5-V SHIFTER WITH 3-STATE OUTPUTS

SCAS375H—MARCH 1994—REVISED MARCH 2005



### Absolute Maximum Ratings<sup>(1)</sup>

over operating free-air temperature range for  $V_{CCA} = 4.5\text{ V to }5.5\text{ V}$  (unless otherwise noted)

			MIN	MAX	UNIT
$V_{CCA}$	Supply voltage range		-0.5	6.5	V
$V_I$	Input voltage range	A port <sup>(2)</sup>	-0.5	$V_{CCA} + 0.5$	V
		Control inputs	-0.5	6	
$V_O$	Output voltage range	A port <sup>(2)</sup>	-0.5	$V_{CCA} + 0.5$	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 each $V_{CCA}$ or GND			±100	mA
$\theta_{JA}$	Package thermal impedance <sup>(3)</sup>	DB package		63	°C/W
		DW package		46	
		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) This value is limited to 6 V maximum.

(3) The package thermal impedance is calculated in accordance with JESD 51-7.

## Absolute Maximum Ratings<sup>(1)</sup>

over operating free-air temperature range for  $V_{CCB} = 2.7\text{ V}$  to  $3.6\text{ V}$  (unless otherwise noted)

			MIN	MAX	UNIT
$V_{CCB}$	Supply voltage range		–0.5	4.6	V
$V_I$	Input voltage range	B port <sup>(2)</sup>	–0.5	$V_{CCB} + 0.5$	V
$V_O$	Output voltage range	B port <sup>(2)</sup>	–0.5	$V_{CCB} + 0.5$	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 $V_{CCB}$ or GND			±100	mA
$\theta_{JA}$	Package thermal impedance <sup>(3)</sup>	DB package		63	°C/W
		DW package		46	
		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) This value is limited to 4.6 V maximum.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

## Recommended Operating Conditions<sup>(1)</sup>

for  $V_{CCA} = 4.5\text{ V}$  to  $5.5\text{ V}$

			MIN	MAX	UNIT
$V_{CCA}$	Supply voltage		4.5	5.5	V
$V_{IH}$	High-level input voltage		2		V
$V_{IL}$	Low-level input voltage			0.8	V
$V_{IA}$	Input voltage		0	$V_{CCA}$	V
$V_{OA}$	Output voltage		0	$V_{CCA}$	V
$I_{OH}$	High-level output current			–24	mA
$I_{OL}$	Low-level output current			24	mA
$T_A$	Operating free-air temperature		–40	85	°C

- (1) All unused inputs of the device must be held at the associated  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## Recommended Operating Conditions<sup>(1)</sup>

for  $V_{CCB} = 2.7\text{ V}$  to  $3.6\text{ V}$

			MIN	MAX	UNIT
$V_{CCB}$	Supply voltage		2.7	3.6	V
$V_{IH}$	High-level input voltage	$V_{CCB} = 2.7\text{ V}$ to $3.6\text{ V}$	2		V
$V_{IL}$	Low-level input voltage	$V_{CCB} = 2.7\text{ V}$ to $3.6\text{ V}$		0.8	V
$V_{IB}$	Input voltage		0	$V_{CCB}$	V
$V_{OB}$	Output voltage		0	$V_{CCB}$	V
$I_{OH}$	High-level output current	$V_{CCB} = 2.7\text{ V}$		–12	mA
		$V_{CCB} = 3\text{ V}$		–24	
$I_{OL}$	Low-level output current	$V_{CCB} = 2.7\text{ V}$		12	mA
		$V_{CCB} = 3\text{ V}$		24	
$T_A$	Operating free-air temperature		–40	85	°C

- (1) All unused inputs of the device must be held at the associated  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

# SN74LVC4245A

## OCTAL BUS TRANSCEIVER AND 3.3-V TO 5-V SHIFTER

### WITH 3-STATE OUTPUTS

SCAS375H–MARCH 1994–REVISED MARCH 2005

#### Electrical Characteristics<sup>(1)</sup>

over recommended operating free-air temperature range for  $V_{CCA} = 4.5\text{ V}$  to  $5.5\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$V_{CCA}$	MIN	TYP <sup>(2)</sup>	MAX	UNIT
$V_{OH}$		$I_{OH} = -100\text{ }\mu\text{A}$	4.5 V	4.3			V
			5.5 V	5.3			
		$I_{OH} = -24\text{ mA}$	4.5 V	3.7			
			5.5 V	4.7			
$V_{OL}$		$I_{OL} = 100\text{ }\mu\text{A}$	4.5 V			0.2	V
			5.5 V			0.2	
		$I_{OL} = 24\text{ mA}$	4.5 V			0.55	
			5.5 V			0.55	
$I_I$	Control inputs	$V_I = V_{CCA}$ or GND	5.5 V			$\pm 1$	$\mu\text{A}$
$I_{OZ}^{(3)}$	A port	$V_O = V_{CCA}$ or GND	5.5 V			$\pm 5$	$\mu\text{A}$
$I_{CCA}$		$V_I = V_{CCA}$ or GND, $I_O = 0$	5.5 V			80	$\mu\text{A}$
$\Delta I_{CCA}^{(4)}$		One input at 3.4 V, Other inputs at $V_{CCA}$ or GND	5.5 V			1.5	mA
$C_i$	Control inputs	$V_I = V_{CCA}$ or GND	Open		5		pF
$C_{io}$	A port	$V_O = V_{CCA}$ or GND	5 V		11		pF

(1)  $V_{CCB} = 2.7\text{ V}$  to  $3.6\text{ V}$

(2) All typical values are measured at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

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

(4) This is the increase in supply current for each input that is at one of the specified TTL voltage levels, rather than 0 V or the associated  $V_{CC}$ .

#### Electrical Characteristics<sup>(1)</sup>

over recommended operating free-air temperature range for  $V_{CCB} = 2.7\text{ V}$  to  $3.6\text{ V}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$V_{CCB}$	MIN	TYP <sup>(2)</sup>	MAX	UNIT
$V_{OH}$		$I_{OH} = -100\text{ }\mu\text{A}$	2.7 V to 3.6 V	$V_{CC} - 0.2$			V
		$I_{OH} = -12\text{ mA}$	2.7 V	2.2			
		$I_{OH} = -24\text{ mA}$	3 V	2.4			
			3 V	2			
$V_{OL}$		$I_{OL} = 100\text{ }\mu\text{A}$	2.7 V to 3.6 V			0.2	V
		$I_{OL} = 12\text{ mA}$	2.7 V			0.4	
		$I_{OL} = 24\text{ mA}$	3 V			0.55	
$I_{OZ}^{(3)}$	B port	$V_O = V_{CCB}$ or GND	3.6 V			$\pm 5$	$\mu\text{A}$
$I_{CCB}$		$V_I = V_{CCB}$ or GND, $I_O = 0$	3.6 V			50	$\mu\text{A}$
$\Delta I_{CCB}^{(4)}$		One input at $V_{CCB} - 0.6\text{ V}$ , Other inputs at $V_{CCB}$ or GND	2.7 V to 3.6 V			0.5	mA
$C_{io}$	B port	$V_O = V_{CCB}$ or GND	3.3 V		11		pF

(1)  $V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$

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

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

(4) This is the increase in supply current for each input that is at one of the specified TTL voltage levels, rather than 0 V or the associated  $V_{CC}$ .

## Switching Characteristics

over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1 and Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$ , $V_{CCB} = 2.7\text{ V to } 3.6\text{ V}$		UNIT
			MIN	MAX	
$t_{PHL}$	A	B	1	6.3	ns
$t_{PLH}$			1	6.7	
$t_{PHL}$	B	A	1	6.1	ns
$t_{PLH}$			1	5	
$t_{PZL}$	$\overline{OE}$	A	1	9	ns
$t_{PZH}$			1	8.1	
$t_{PZL}$	$\overline{OE}$	B	1	8.8	ns
$t_{PZH}$			1	9.8	
$t_{PLZ}$	$\overline{OE}$	A	1	7	ns
$t_{PHZ}$			1	5.8	
$t_{PLZ}$	$\overline{OE}$	B	1	7.7	ns
$t_{PHZ}$			1	7.8	

## Operating Characteristics

$V_{CCA} = 4.5\text{ V to } 5.5\text{ V}$ ,  $V_{CCB} = 2.7\text{ V to } 3.6\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER			TEST CONDITIONS	TYP	UNIT
$C_{pd}$	Power dissipation capacitance per transceiver	Outputs enabled	$C_L = 0$ , $f = 10\text{ MHz}$	39.5	pF
		Outputs disabled		5	

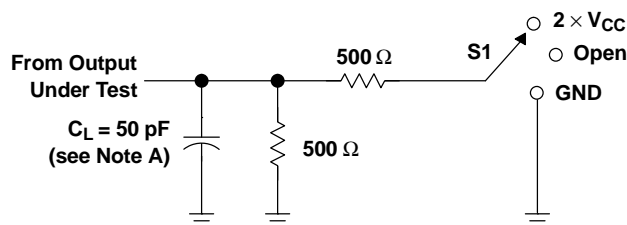
## Power-Up Considerations<sup>(1)</sup>

TI level-translation devices offer an opportunity for successful mixed-voltage signal design. A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies caused by improperly biased device pins. Take these precautions to guard against such power-up problems:

1. Connect ground before any supply voltage is applied.
2. Power up the control side of the device ( $V_{CCA}$  for all four of these devices).
3. Tie  $\overline{OE}$  to  $V_{CCA}$  with a pullup resistor so that it ramps with  $V_{CCA}$ .
4. Depending on the direction of the data path, DIR can be high or low. If DIR high is needed (A data to B bus), ramp it with  $V_{CCA}$ . Otherwise, keep DIR low.

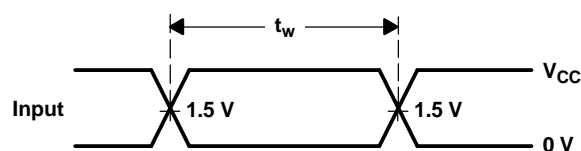
(1) Refer to the TI application report, *Texas Instruments Voltage-Level-Translation Devices*, literature number SCEA021.

# **PARAMETER MEASUREMENT INFORMATION** **A PORT**

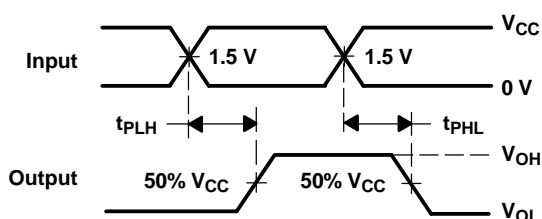


**LOAD CIRCUIT**

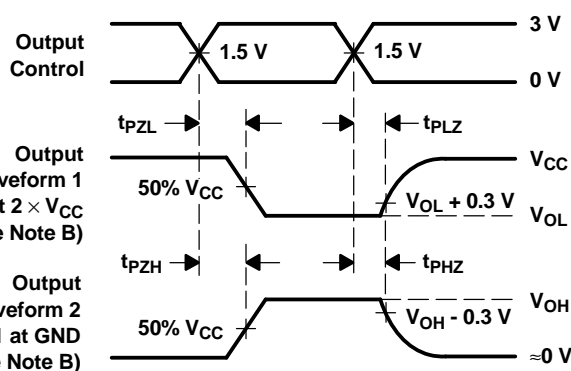
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	GND



**VOLTAGE WAVEFORMS**  
**PULSE DURATION**



**VOLTAGE WAVEFORMS**  
**PROPAGATION DELAY TIMES**  
**NONINVERTING OUTPUTS**

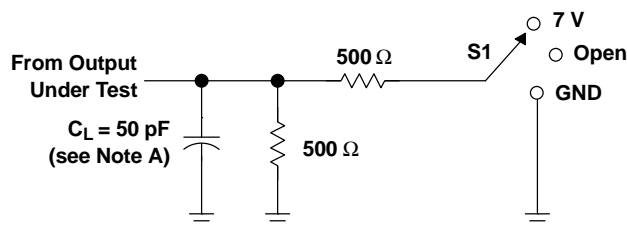


**VOLTAGE WAVEFORMS**  
**ENABLE AND DISABLE TIMES**  
**LOW- AND HIGH-LEVEL ENABLING**

- 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.  
E. All parameters and waveforms are not applicable to all devices.

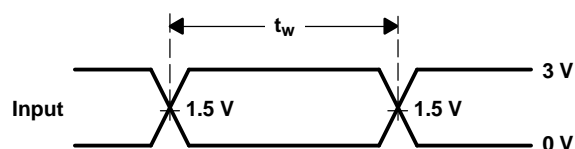
**Figure 1. Load Circuit and Voltage Waveforms**

## PARAMETER MEASUREMENT INFORMATION B PORT

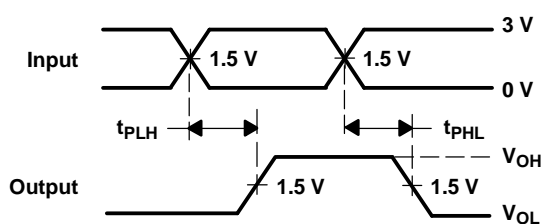


TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	GND

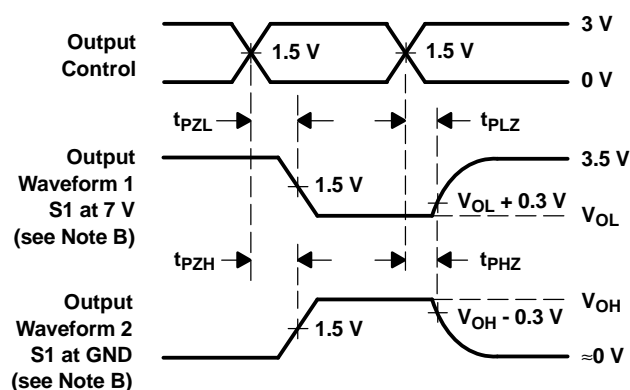
LOAD CIRCUIT



VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74LVC4245ADBR	ACTIVE	SSOP	DB	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245ADBRE4	ACTIVE	SSOP	DB	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245ADW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245ADWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245ADWR	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245ADWRE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APW	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APWE4	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APWG4	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APWR	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APWRE4	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APWRG4	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APWT	ACTIVE	TSSOP	PW	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC4245APWTE4	ACTIVE	TSSOP	PW	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

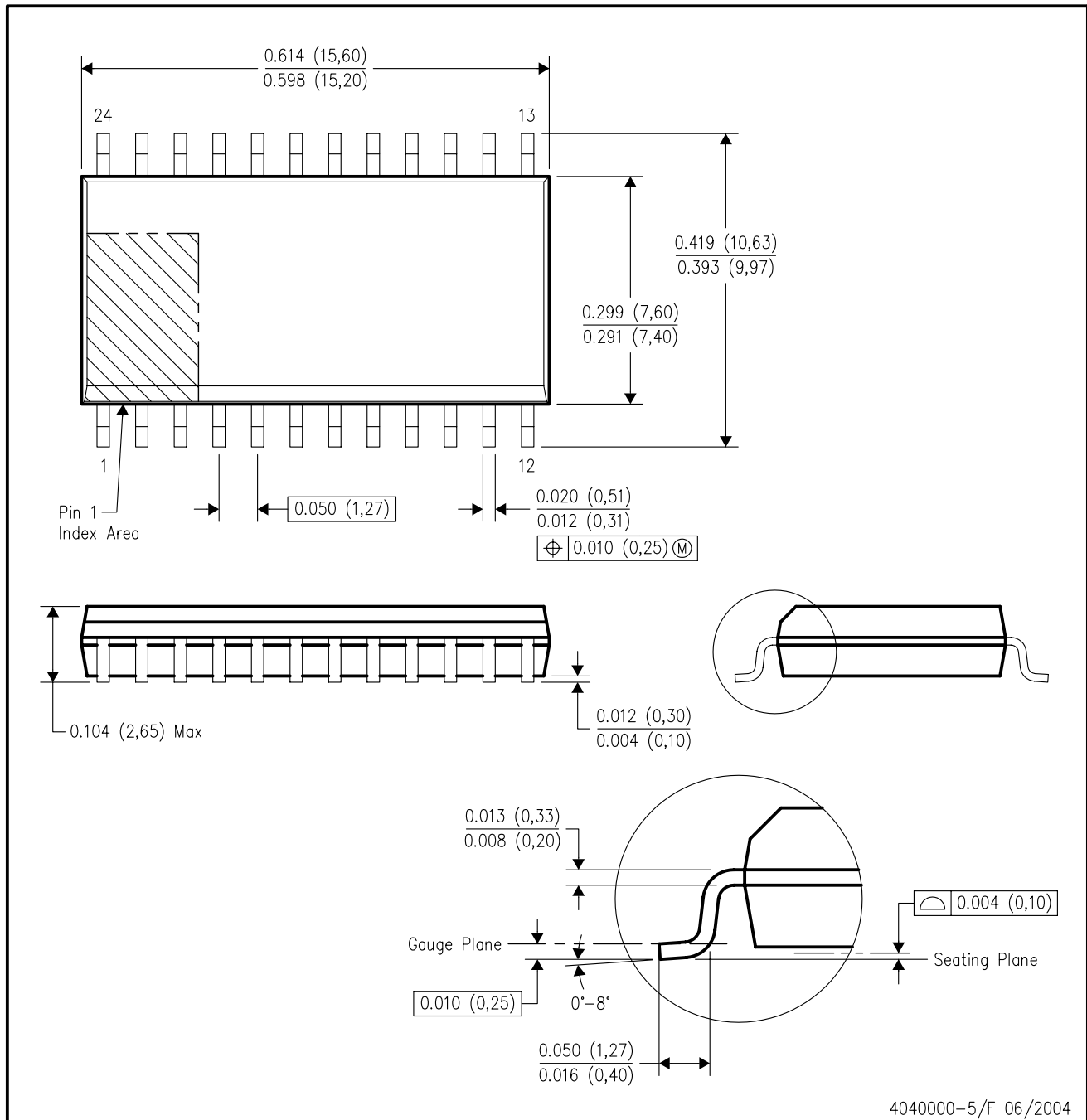
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## DW (R-PDSO-G24)

## PLASTIC SMALL-OUTLINE PACKAGE

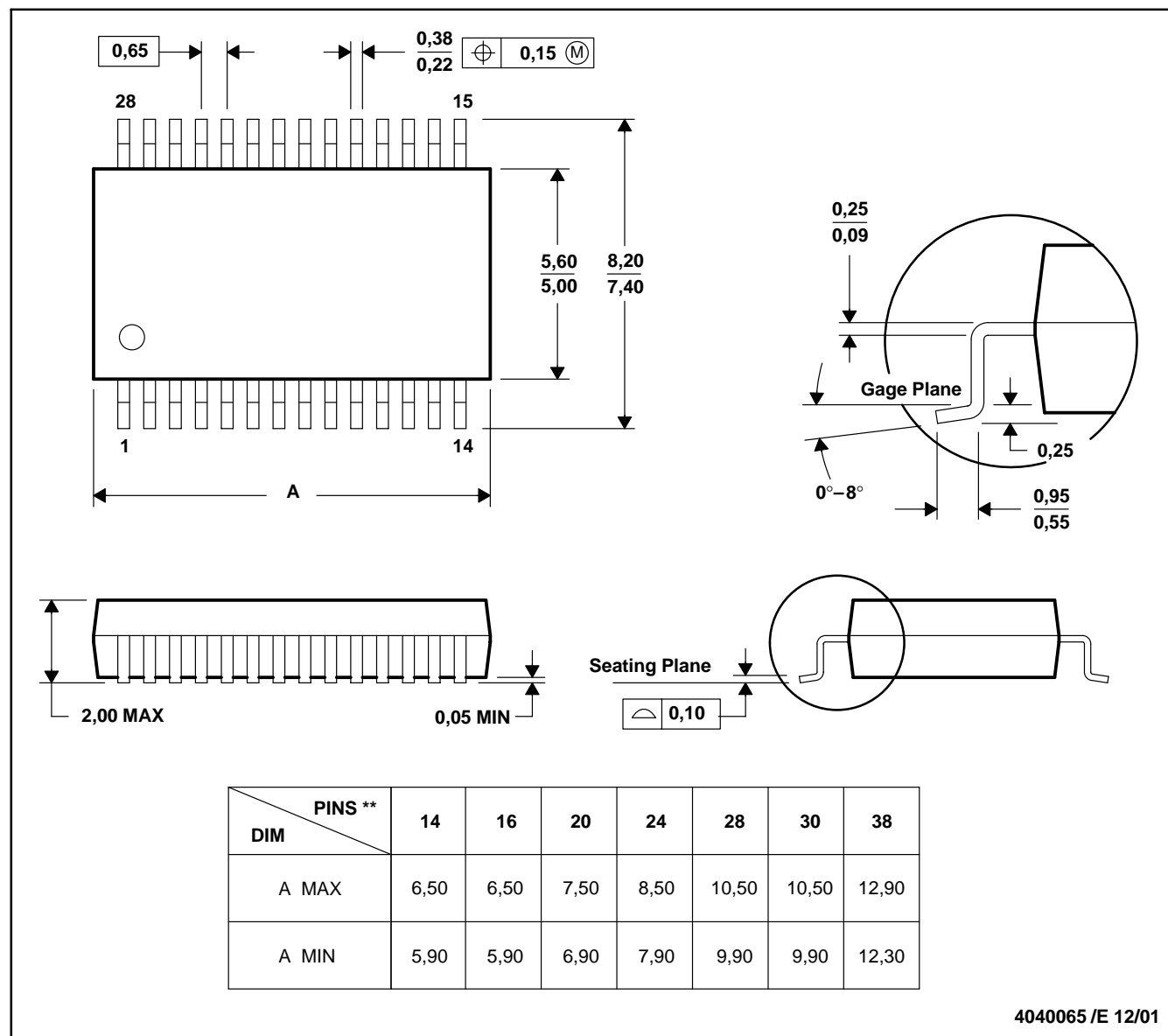


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-013 variation AD.

## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN

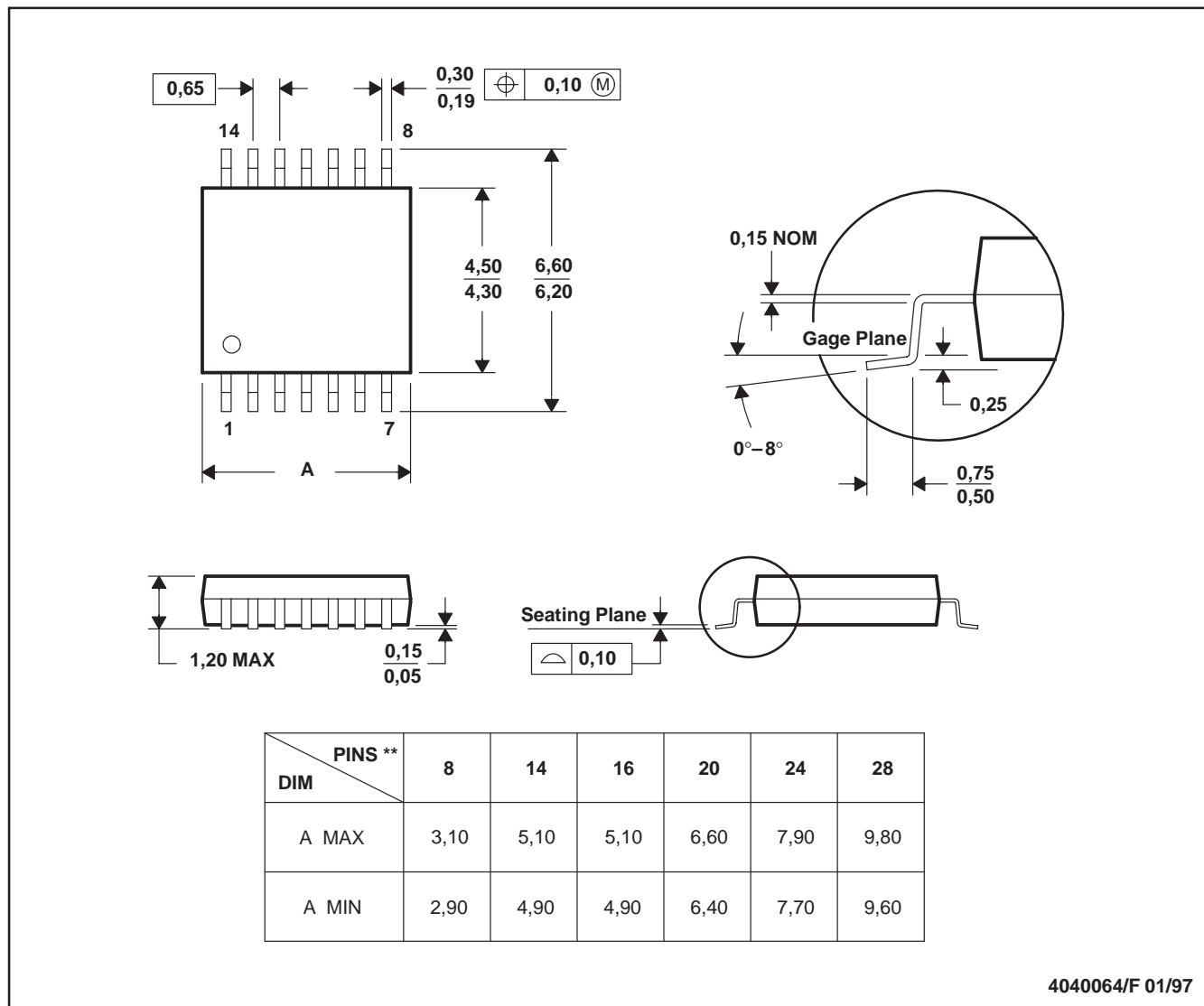


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-150

## PW (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.  
 D. Falls within JEDEC MO-153

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