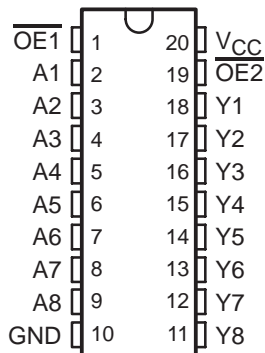


# SN54LV541A, SN74LV541A OCTAL BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

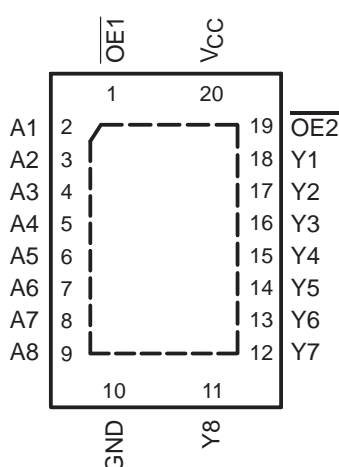
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- 2-V to 5.5-V  $V_{CC}$  Operation
- Max  $t_{pd}$  of 6 ns at 5 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $>2.3$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Support Mixed-Mode Voltage Operation on All Ports
- $I_{off}$  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)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

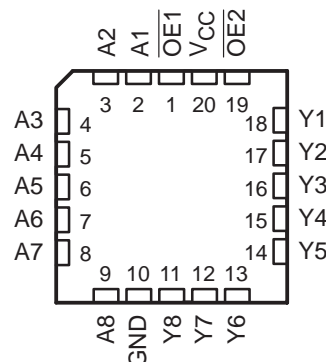
SN54LV541A . . . J OR W PACKAGE  
SN74LV541A . . . DB, DGV, DW, NS,  
OR PW PACKAGE  
(TOP VIEW)



SN74LV541A . . . RGY PACKAGE  
(TOP VIEW)



SN54LV541A . . . FK PACKAGE  
(TOP VIEW)



## description/ordering information

The 'LV541A devices are octal buffers/drivers designed for 2-V to 5.5-V  $V_{CC}$  operation.

## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	QFN – RGY	Reel of 1000	SN74LV541ARGYR	LV541A
	SOIC – DW	Tube of 25	SN74LV541ADW	LV541A
		Reel of 2000	SN74LV541ADWR	
	SOP – NS	Reel of 2000	SN74LV541ANSR	74LV541A
	SSOP – DB	Reel of 2000	SN74LV541ADBR	LV541A
	TSSOP – PW	Tube of 70	SN74LV541APW	LV541A
		Reel of 2000	SN74LV541APWR	
		Reel of 250	SN74LV541APWT	
	TVSOP – DGV	Reel of 2000	SN74LV541ADGVR	LV541A
–55°C to 125°C	CDIP – J	Tube of 20	SNJ54LV541AJ	SNJ54LV541AJ
	CFP – W	Tube of 85	SNJ54LV541AW	SNJ54LV541AW
	LCCC – FK	Tube of 55	SNJ54LV541AFK	SNJ54LV541AFK

† 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).



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UNLESS OTHERWISE NOTED this document contains PRODUCTION DATA information 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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**SN54LV541A, SN74LV541A**  
**OCTAL BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

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**description/ordering information (continued)**

These devices are ideal for driving bus lines or buffer memory address registers. They feature inputs and outputs on opposite sides of the package to facilitate printed circuit board layout.

The 3-state control gate is a two-input AND gate with active-low inputs so that if either output-enable ( $\overline{OE1}$  or  $\overline{OE2}$ ) input is high, all corresponding outputs are in the high-impedance state. The outputs provide noninverted data when they are not in the high-impedance state.

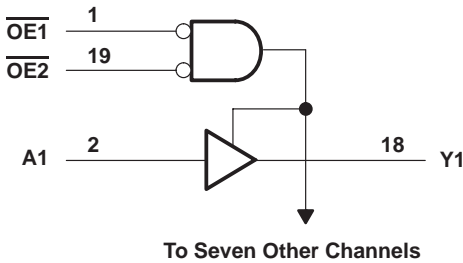
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

These devices are fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down.

**FUNCTION TABLE**  
(each buffer/driver)

INPUTS			OUTPUT
$\overline{OE1}$	$\overline{OE2}$	A	Y
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

**logic diagram (positive logic)**



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

Supply voltage range, $V_{CC}$	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high-impedance or power-off state, $V_O$ (see Note 1)	–0.5 V to 7 V
Output voltage range applied in the high or low state, $V_O$ (see Notes 1 and 2)	–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, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	±35 mA
Continuous current through $V_{CC}$ or GND	±70 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): DB package	70°C/W
(see Note 3): DGV package	92°C/W
(see Note 3): DW package	58°C/W
(see Note 3): NS package	60°C/W
(see Note 3): PW package	83°C/W
(see Note 4): RGY package	37°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 negative-voltage ratings may be exceeded if the input and output current ratings are observed.
  2. This value is limited to 5.5 V maximum.
  3. The package thermal impedance is calculated in accordance with JESD 51-7.
  4. The package thermal impedance is calculated in accordance with JESD 51-5.

# SN54LV541A, SN74LV541A

## OCTAL BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

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#### recommended operating conditions (see Note 5)

			SN54LV541A		SN74LV541A		UNIT
			MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage		2	5.5	2	5.5	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2 V	1.5		1.5		V
		V <sub>CC</sub> = 2.3 V to 2.7 V	V <sub>CC</sub> × 0.7		V <sub>CC</sub> × 0.7		
		V <sub>CC</sub> = 3 V to 3.6 V	V <sub>CC</sub> × 0.7		V <sub>CC</sub> × 0.7		
		V <sub>CC</sub> = 4.5 V to 5.5 V	V <sub>CC</sub> × 0.7		V <sub>CC</sub> × 0.7		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V	0.5		0.5		V
		V <sub>CC</sub> = 2.3 V to 2.7 V	V <sub>CC</sub> × 0.3		V <sub>CC</sub> × 0.3		
		V <sub>CC</sub> = 3 V to 3.6 V	V <sub>CC</sub> × 0.3		V <sub>CC</sub> × 0.3		
		V <sub>CC</sub> = 4.5 V to 5.5 V	V <sub>CC</sub> × 0.3		V <sub>CC</sub> × 0.3		
V <sub>I</sub>	Input voltage		0	5.5	0	5.5	V
V <sub>O</sub>	Output voltage	High or low state	0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
		3-state	0	5.5	0	5.5	
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 2 V	–50		–50		μA
		V <sub>CC</sub> = 2.3 V to 2.7 V	–2		–2		mA
		V <sub>CC</sub> = 3 V to 3.6 V	–8		–8		
		V <sub>CC</sub> = 4.5 V to 5.5 V	–16		–16		
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 2 V	50		50		μA
		V <sub>CC</sub> = 2.3 V to 2.7 V	2		2		mA
		V <sub>CC</sub> = 3 V to 3.6 V	8		8		
		V <sub>CC</sub> = 4.5 V to 5.5 V	16		16		
Δt/Δv	Input transition rise or fall rate	V <sub>CC</sub> = 2.3 V to 2.7 V	200		200		ns/V
		V <sub>CC</sub> = 3 V to 3.6 V	100		100		
		V <sub>CC</sub> = 4.5 V to 5.5 V	20		20		
T <sub>A</sub>	Operating free-air temperature		–55	125	–40	85	°C

NOTE 5: 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 (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	SN54LV541A			SN74LV541A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = −50 μA	2 V to 5.5 V	V <sub>CC</sub> −0.1			V <sub>CC</sub> −0.1			V
	I <sub>OH</sub> = −2 mA	2.3 V	2			2			
	I <sub>OH</sub> = −8 mA	3 V	2.48			2.48			
	I <sub>OH</sub> = −16 mA	4.5 V	3.8			3.8			
V <sub>OL</sub>	I <sub>OL</sub> = 50 μA	2 V to 5.5 V	0.1			0.1			V
	I <sub>OL</sub> = 2 mA	2.3 V	0.4			0.4			
	I <sub>OL</sub> = 8 mA	3 V	0.44			0.44			
	I <sub>OL</sub> = 16 mA	4.5 V	0.55			0.55			
I <sub>I</sub>	V <sub>I</sub> = 5.5 V or GND	0 to 5.5 V	±1			±1			μA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5.5 V	±5			±5			μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V	20			20			μA
I <sub>off</sub>	V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V	0	5			5			μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V	2			2			pF

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



# SN54LV541A, SN74LV541A OCTAL BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

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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	$T_A = 25^\circ\text{C}$			SN54LV541A		SN74LV541A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	Y	$C_L = 15\text{ pF}$	6.7*	11.3*	1*	13.5*	1	13.5	1	ns
$t_{en}$	$\overline{OE}$	Y		8.5*	16.6*	1*	19.5*	1	19.5	1	
$t_{dis}$	$\overline{OE}$	Y		8.4*	13.1*	1*	15*	1	15	1	
$t_{pd}$	A	Y	$C_L = 50\text{ pF}$	8.7	15.9	1	18.5	1	18.5	1	ns
$t_{en}$	$\overline{OE}$	Y		10.5	20.7	1	24	1	24	1	
$t_{dis}$	$\overline{OE}$	Y		12.3	17.9	1	20	1	20	1	
$t_{sk(o)}$					2					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	$T_A = 25^\circ\text{C}$			SN54LV541A		SN74LV541A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	Y	$C_L = 15\text{ pF}$	4.8*	7*	1*	8.5*	1	8.5	1	ns
$t_{en}$	$\overline{OE}$	Y		6.1*	10.5*	1*	12.5*	1	12.5	1	
$t_{dis}$	$\overline{OE}$	Y		5.8*	11*	1*	12*	1	12	1	
$t_{pd}$	A	Y	$C_L = 50\text{ pF}$	6.1	10.5	1	12	1	12	1	ns
$t_{en}$	$\overline{OE}$	Y		7.4	14	1	16	1	16	1	
$t_{dis}$	$\overline{OE}$	Y		8.8	15.4	1	17.5	1	17.5	1	
$t_{sk(o)}$					1.5					1.5	

\* 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	$T_A = 25^\circ\text{C}$			SN54LV541A		SN74LV541A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	Y	$C_L = 15\text{ pF}$	3.5*	5*	1*	6*	1	6	1	ns
$t_{en}$	$\overline{OE}$	Y		4.3*	7.2*	1*	8.5*	1	8.5	1	
$t_{dis}$	$\overline{OE}$	Y		3.9*	7.5*	1*	8*	1	8	1	
$t_{pd}$	A	Y	$C_L = 50\text{ pF}$	4.3	7	1	8	1	8	1	ns
$t_{en}$	$\overline{OE}$	Y		5.3	9.2	1	10.5	1	10.5	1	
$t_{dis}$	$\overline{OE}$	Y		5.6	8.8	1	10	1	10	1	
$t_{sk(o)}$					1					1	

\* On products compliant to MIL-PRF-38535, this parameter is not production tested.

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# SN54LV541A, SN74LV541A

## OCTAL BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

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noise characteristics,  $V_{CC} = 3.3\text{ V}$ ,  $C_L = 50\text{ pF}$ ,  $T_A = 25^\circ\text{C}$  (see Note 6)

PARAMETER	SN74LV541A			UNIT
	MIN	TYP	MAX	
$V_{OL(P)}$ Quiet output, maximum dynamic $V_{OL}$		0.5	0.8	V
$V_{OL(V)}$ Quiet output, minimum dynamic $V_{OL}$		–0.4	–0.8	V
$V_{OH(V)}$ Quiet output, minimum dynamic $V_{OH}$		2.9		V
$V_{IH(D)}$ High-level dynamic input voltage	2.31			V
$V_{IL(D)}$ Low-level dynamic input voltage			0.99	V

NOTE 6: Characteristics are for surface-mount packages only.

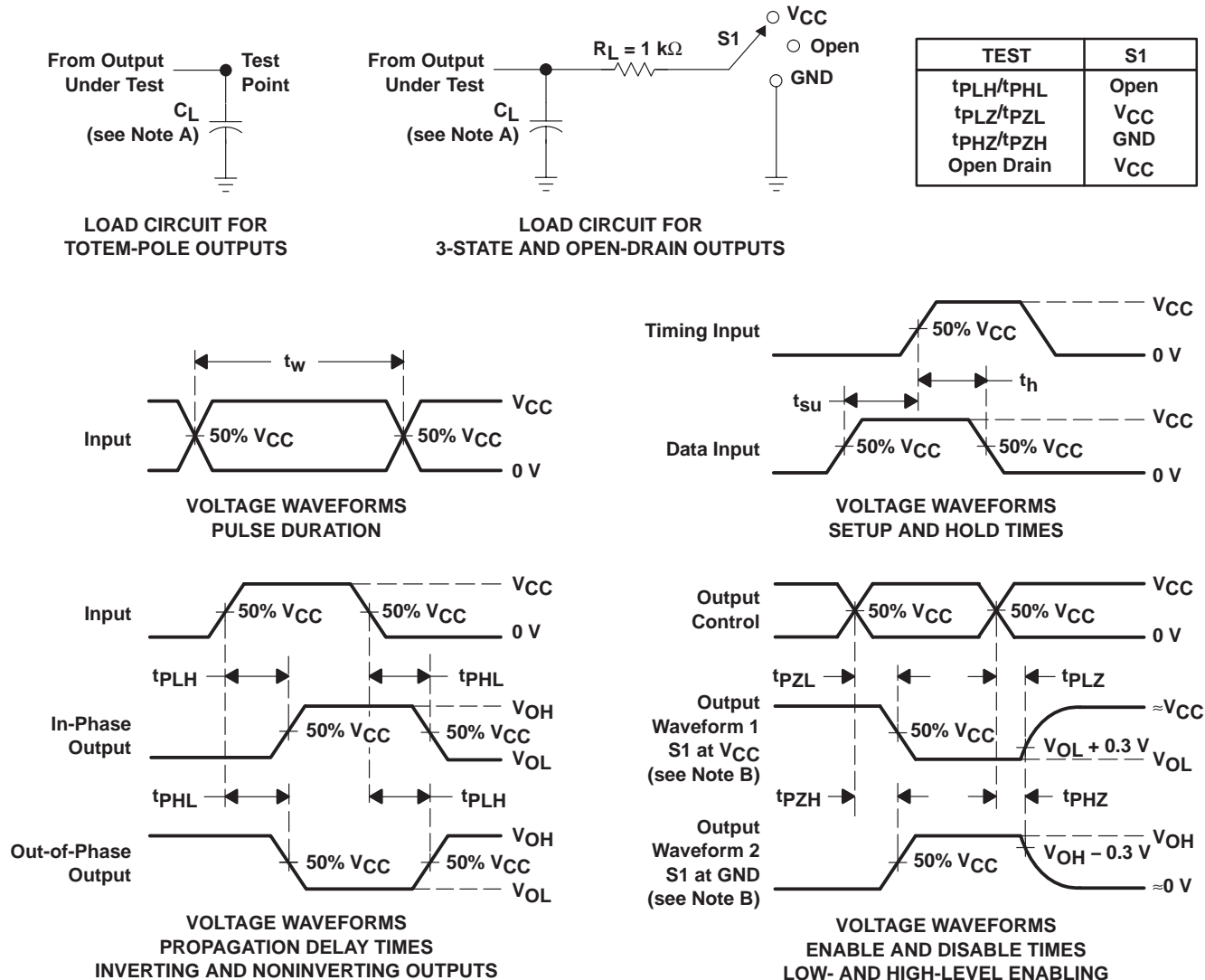
operating characteristics,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	$V_{CC}$	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	Outputs enabled	$C_L = 50\text{ pF}$ , $f = 10\text{ MHz}$	3.3 V	16.3	pF
			5 V	17.8	



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## PARAMETER MEASUREMENT INFORMATION



- 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:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 3\text{ ns}$ ,  $t_f \leq 3\text{ ns}$ .
  - D. The outputs are measured one at a time, with one input transition per measurement.
  - E.  $t_{PLZ}$  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 <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74LV541ADBR	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ADBRE4	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ADGVR	ACTIVE	TVSOP	DGV	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ADGVRE4	ACTIVE	TVSOP	DGV	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ADW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ADWE4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ADWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ADWRE4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ANSR	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ANSRE4	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ANSRG4	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541APW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541APWE4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541APWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541APWRE4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541APWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541APWT	ACTIVE	TSSOP	PW	20	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541APWTE4	ACTIVE	TSSOP	PW	20	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV541ARGYR	ACTIVE	QFN	RGY	20	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
SN74LV541ARGYRG4	ACTIVE	QFN	RGY	20	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR

<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.

**OBsolete:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

**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.

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

## PLASTIC SMALL-OUTLINE

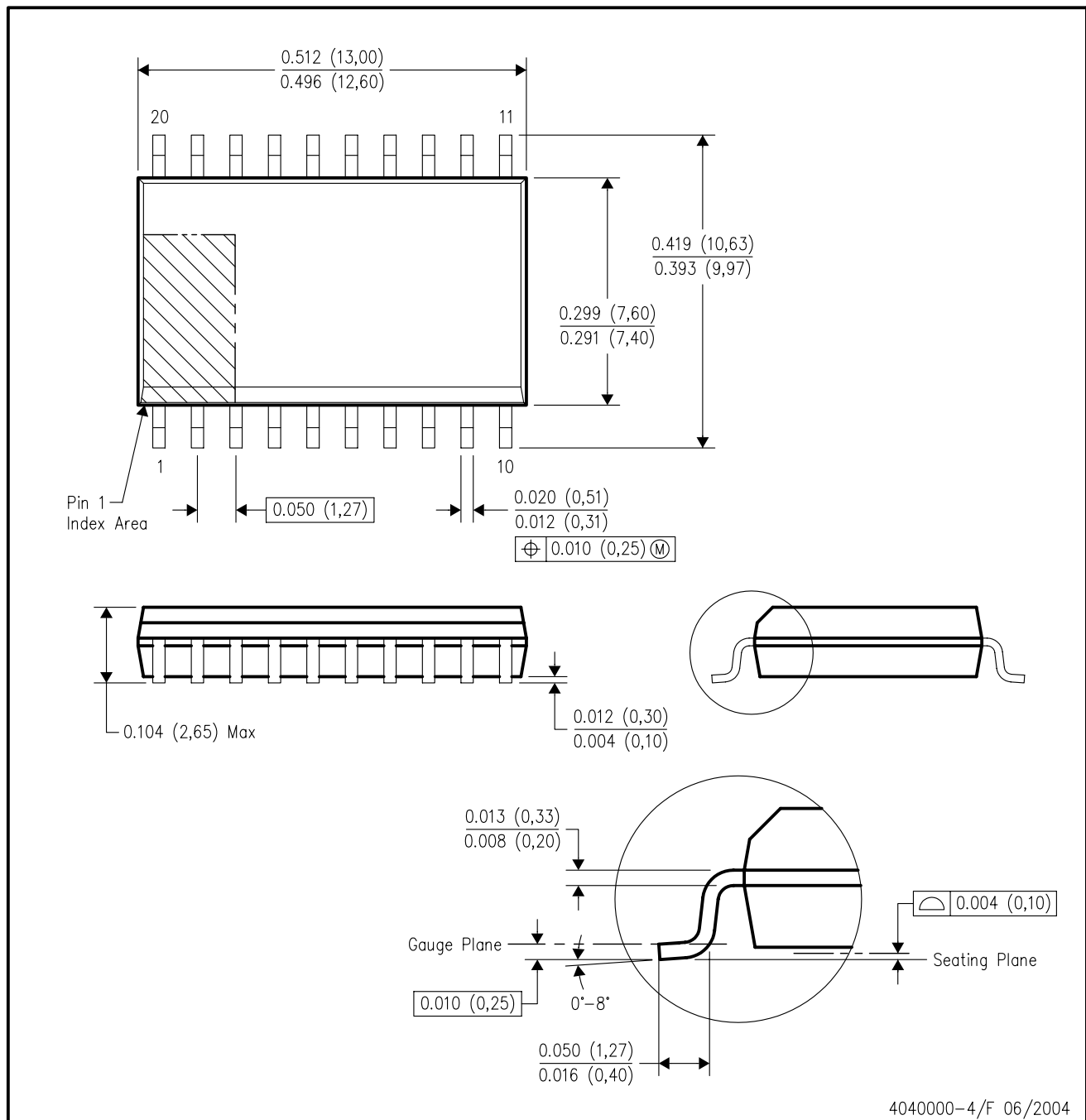
24 PINS SHOWN



- 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

DW (R-PDSO-G20)

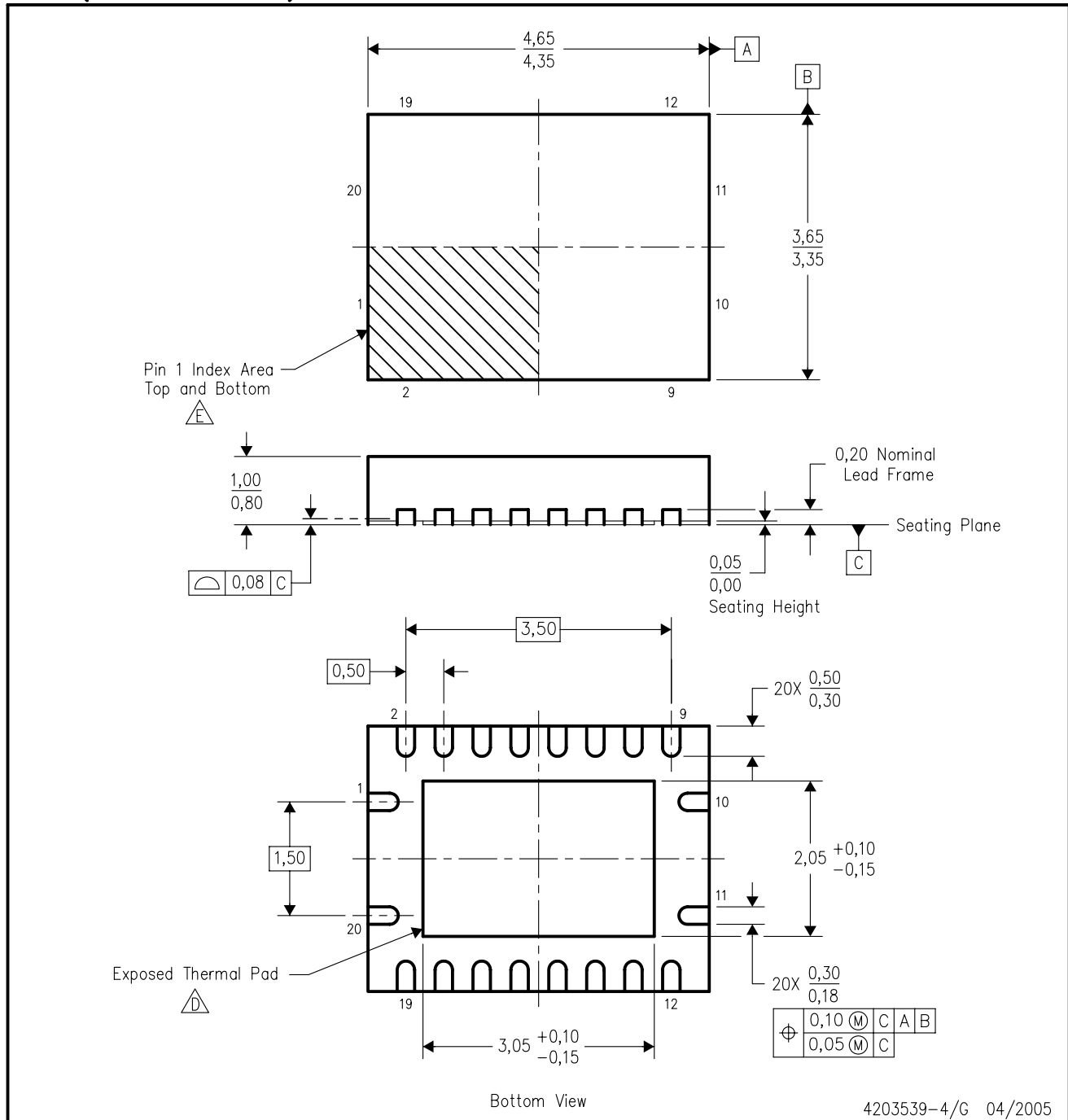
PLASTIC SMALL-OUTLINE PACKAGE



- 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 MS-013 variation AC.

RGY (R-PQFP-N20)

PLASTIC QUAD FLATPACK



4203539-4/G 04/2005

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - QFN (Quad Flatpack No-Lead) package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
  - Package complies to JEDEC MO-241 variation BC.

# 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

## 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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