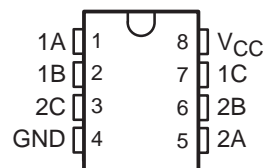


# SN74LVC2G66 DUAL BILATERAL ANALOG SWITCH

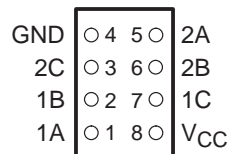
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- Available in the Texas Instruments NanoStar™ and NanoFree™ Packages
- 1.65-V to 5.5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 0.8 ns at 3.3 V
- High On-Off Output Voltage Ratio
- High Degree of Linearity
- High Speed, Typically 0.5 ns ( $V_{CC} = 3$  V,  $C_L = 50$  pF)
- Rail-to-Rail Input/Output
- Low On-State Resistance, Typically  $\approx 6 \Omega$  ( $V_{CC} = 4.5$  V)
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II

DCT OR DCU PACKAGE  
(TOP VIEW)



YEA, YEP, YZA, OR YZP PACKAGE  
(BOTTOM VIEW)



## description/ordering information

This dual bilateral analog switch is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

The SN74LVC2G66 can handle both analog and digital signals. The device permits signals with amplitudes of up to 5.5 V (peak) to be transmitted in either direction.

NanoStar™ and NanoFree™ package technology is a major breakthrough in IC packaging concepts, using the die as the package.

Each switch section has its own enable-input control (C). A high-level voltage applied to C turns on the associated switch section.

## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	NanoStar™ – WCSP (DSBGA) 0.17-mm Small Bump – YEA	Reel of 3000	SN74LVC2G66YEAR	_ _ _ C6 _
	NanoFree™ – WCSP (DSBGA) 0.17-mm Small Bump – YZA (Pb-free)		SN74LVC2G66YZAR	
	NanoStar™ – WCSP (DSBGA) 0.23-mm Large Bump – YEP		SN74LVC2G66YEPR	
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)		SN74LVC2G66YZPR	
	SSOP – DCT	Reel of 3000	SN74LVC2G66DCTR	C66 _ _ _
	VSSOP – DCU	Reel of 3000	SN74LVC2G66DCUR	C66 _
		Reel of 250	SN74LVC2G66DCUT	

† 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).

‡ DCT: The actual top-side marking has three additional characters that designate the year, month, and assembly/test site.

DCU: The actual top-side marking has one additional character that designates the assembly/test site.

YEA/YZA, YEP/YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).



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.

NanoStar and NanoFree are trademarks of Texas Instruments.

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.



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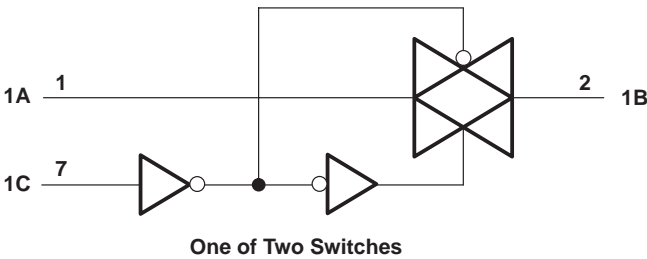
description/ordering information (continued)

Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

FUNCTION TABLE  
(each section)

CONTROL INPUT (C)	SWITCH
L	Off
H	On

logic diagram, each switch (positive logic)



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

Supply voltage range, $V_{CC}$ (see Note 1)	–0.5 V to 6.5 V
Input voltage range, $V_I$ (see Notes 1 and 2)	–0.5 V to 6.5 V
Switch I/O voltage range, $V_{I/O}$ (see Notes 1, 2, and 3)	–0.5 V to $V_{CC} + 0.5$ V
Control input clamp current, $I_{IK}$ ( $V_I < 0$ )	–50 mA
I/O port diode current, $I_{IOK}$ ( $V_{I/O} < 0$ or $V_{I/O} > V_{CC}$ )	±50 mA
On-state switch current, $I_T$ ( $V_{I/O} = 0$ to $V_{CC}$ )	±50 mA
Continuous current through $V_{CC}$ or GND	±100 mA
Package thermal impedance, $\theta_{JA}$ (see Note 4):	
DCT package	220°C/W
DCU package	227°C/W
YEA/YZA package	140°C/W
YEP/YZP package	102°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. All voltages are with respect to ground unless otherwise specified.
  2. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
  3. This value is limited to 5.5 V maximum.
  4. The package thermal impedance is calculated in accordance with JESD 51-7.

# SN74LVC2G66

## DUAL BILATERAL ANALOG SWITCH

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### recommended operating conditions (see Note 5)

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage	1.65	5.5	V
$V_{I/O}$	I/O port voltage	0	$V_{CC}$	V
$V_{IH}$	High-level input voltage, control input	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$V_{CC} \times 0.65$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	$V_{CC} \times 0.7$	
		$V_{CC} = 3\text{ V to }3.6\text{ V}$	$V_{CC} \times 0.7$	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	$V_{CC} \times 0.7$	
$V_{IL}$	Low-level input voltage, control input	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$V_{CC} \times 0.35$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	$V_{CC} \times 0.3$	
		$V_{CC} = 3\text{ V to }3.6\text{ V}$	$V_{CC} \times 0.3$	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	$V_{CC} \times 0.3$	
$V_I$	Control input voltage	0	5.5	V
$\Delta t/\Delta v$	Input transition rise/fall time	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	20	ns/V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	20	
		$V_{CC} = 3\text{ V to }3.6\text{ V}$	10	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	10	
$T_A$	Operating free-air temperature	-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.

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## DUAL BILATERAL ANALOG SWITCH

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

PARAMETER		TEST CONDITIONS		V <sub>CC</sub>	MIN	TYP†	MAX	UNIT
r <sub>on</sub>	On-state switch resistance	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>C</sub> = V <sub>IH</sub> (see Figures 1 and 2)	I <sub>S</sub> = 4 mA	1.65 V		12.5	30	Ω
			I <sub>S</sub> = 8 mA	2.3 V		9	20	
			I <sub>S</sub> = 24 mA	3 V		7.5	15	
			I <sub>S</sub> = 32 mA	4.5 V		6	10	
r <sub>on(p)</sub>	Peak on-state resistance	V <sub>I</sub> = V <sub>CC</sub> to GND, V <sub>C</sub> = V <sub>IH</sub> (see Figures 1 and 2)	I <sub>S</sub> = 4 mA	1.65 V		85	120	Ω
			I <sub>S</sub> = 8 mA	2.3 V		22	30	
			I <sub>S</sub> = 24 mA	3 V		12	20	
			I <sub>S</sub> = 32 mA	4.5 V		7.5	15	
Δr <sub>on</sub>	Difference of on-state resistance between switches	V <sub>I</sub> = V <sub>CC</sub> to GND, V <sub>C</sub> = V <sub>IH</sub> (see Figures 1 and 2)	I <sub>S</sub> = 4 mA	1.65 V			7	Ω
			I <sub>S</sub> = 8 mA	2.3 V			5	
			I <sub>S</sub> = 24 mA	3 V			3	
			I <sub>S</sub> = 32 mA	4.5 V			2	
I <sub>S(off)</sub>	Off-state switch leakage current	V <sub>I</sub> = V <sub>CC</sub> and V <sub>O</sub> = GND or V <sub>I</sub> = GND and V <sub>O</sub> = V <sub>CC</sub> , V <sub>C</sub> = V <sub>IL</sub> (see Figure 3)		5.5 V			±1 ±0.1†	μA
I <sub>S(on)</sub>	On-state switch leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>C</sub> = V <sub>IH</sub> , V <sub>O</sub> = Open (see Figure 4)		5.5 V			±1 ±0.1†	μA
I <sub>I</sub>	Control input current	V <sub>C</sub> = V <sub>CC</sub> or GND		5.5 V			±1 ±0.1†	μA
I <sub>CC</sub>	Supply current	V <sub>C</sub> = V <sub>CC</sub> or GND		5.5 V			10 1†	μA
ΔI <sub>CC</sub>	Supply-current change	V <sub>C</sub> = V <sub>CC</sub> – 0.6 V		5.5 V			500	μA
C <sub>ic</sub>	Control input capacitance			5 V		3.5		pF
C <sub>io(off)</sub>	Switch input/output capacitance			5 V		6		pF
C <sub>io(on)</sub>	Switch input/output capacitance			5 V		14		pF

† T<sub>A</sub> = 25°C

**switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 5)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 1.8 V ± 0.15 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub> ‡	A or B	B or A		2		1.2		0.8		0.6	ns
t <sub>en</sub> §	C	A or B	2.3	10	1.6	5.6	1.5	4.4	1.3	3.9	ns
t <sub>dis</sub> ¶	C	A or B	2.5	10.5	1.2	6.9	2	7.2	1.1	6.3	ns

‡ t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>. The propagation delay is the calculated RC time constant of the typical on-state resistance of the switch and the specified load capacitance, when driven by an ideal voltage source (zero output impedance).

§ t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.

¶ t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.

# SN74LVC2G66

## DUAL BILATERAL ANALOG SWITCH

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### analog switch characteristics, $T_A = 25^\circ\text{C}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V <sub>CC</sub>	TYP	UNIT
Frequency response <sup>†</sup> (switch on)	A or B	B or A	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = \text{sine wave}$ (see Figure 6)	1.65 V	35	MHz
				2.3 V	120	
				3 V	175	
				4.5 V	195	
			$C_L = 5\text{ pF}$ , $R_L = 50\ \Omega$ , $f_{in} = \text{sine wave}$ (see Figure 6)	1.65 V	>300	
				2.3 V	>300	
				3 V	>300	
				4.5 V	>300	
Crosstalk <sup>‡</sup> (between switches)	A or B	B or A	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see Figure 7)	1.65 V	-58	dB
				2.3 V	-58	
				3 V	-58	
				4.5 V	-58	
			$C_L = 5\text{ pF}$ , $R_L = 50\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see Figure 7)	1.65 V	-42	
				2.3 V	-42	
				3 V	-42	
				4.5 V	-42	
Crosstalk (control input to signal output)	C	A or B	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (square wave) (see Figure 8)	1.65 V	35	mV
				2.3 V	50	
				3 V	70	
				4.5 V	100	
Feed-through attenuation <sup>‡</sup> (switch off)	A or B	B or A	$C_L = 50\text{ pF}$ , $R_L = 600\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see Figure 9)	1.65 V	-58	dB
				2.3 V	-58	
				3 V	-58	
				4.5 V	-58	
			$C_L = 5\text{ pF}$ , $R_L = 50\ \Omega$ , $f_{in} = 1\text{ MHz}$ (sine wave) (see Figure 9)	1.65 V	-42	
				2.3 V	-42	
				3 V	-42	
				4.5 V	-42	
Sine-wave distortion	A or B	B or A	$C_L = 50\text{ pF}$ , $R_L = 10\text{ k}\Omega$ , $f_{in} = 1\text{ kHz}$ (sine wave) (see Figure 10)	1.65 V	0.1	%
				2.3 V	0.025	
				3 V	0.015	
				4.5 V	0.01	
			$C_L = 50\text{ pF}$ , $R_L = 10\text{ k}\Omega$ , $f_{in} = 10\text{ kHz}$ (sine wave) (see Figure 10)	1.65 V	0.15	
				2.3 V	0.025	
				3 V	0.015	
				4.5 V	0.01	

<sup>†</sup> Adjust  $f_{in}$  voltage to obtain 0 dBm at output. Increase  $f_{in}$  frequency until dB meter reads -3 dB.

<sup>‡</sup> Adjust  $f_{in}$  voltage to obtain 0 dBm at input.

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub> = 1.8 V	V <sub>CC</sub> = 2.5 V	V <sub>CC</sub> = 3.3 V	V <sub>CC</sub> = 5 V	UNIT
		TYP	TYP	TYP	TYP	
C <sub>pd</sub> Power dissipation capacitance	f = 10 MHz	8	9	9.5	11	pF



# SN74LVC2G66 DUAL BILATERAL ANALOG SWITCH

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## PARAMETER MEASUREMENT INFORMATION

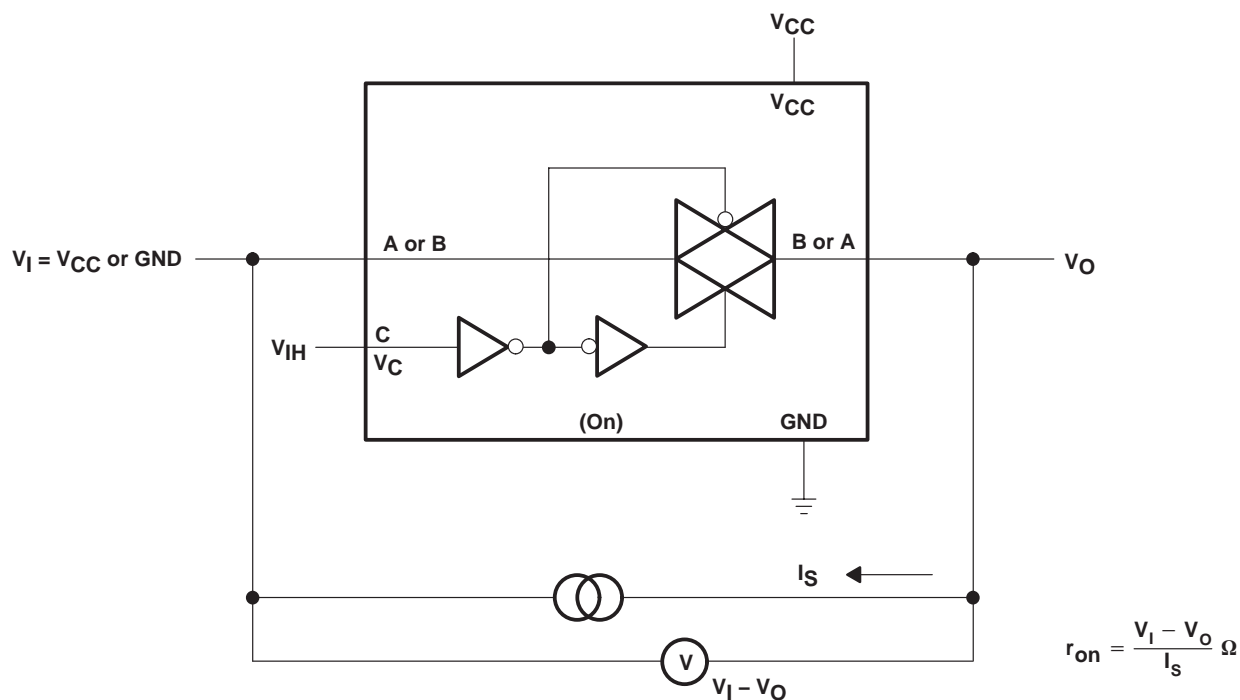


Figure 1. On-State Resistance Test Circuit

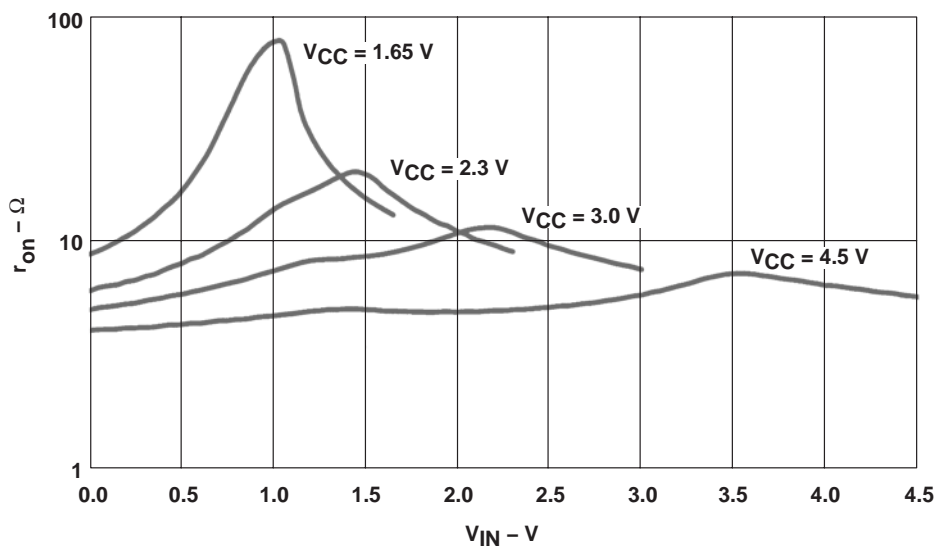
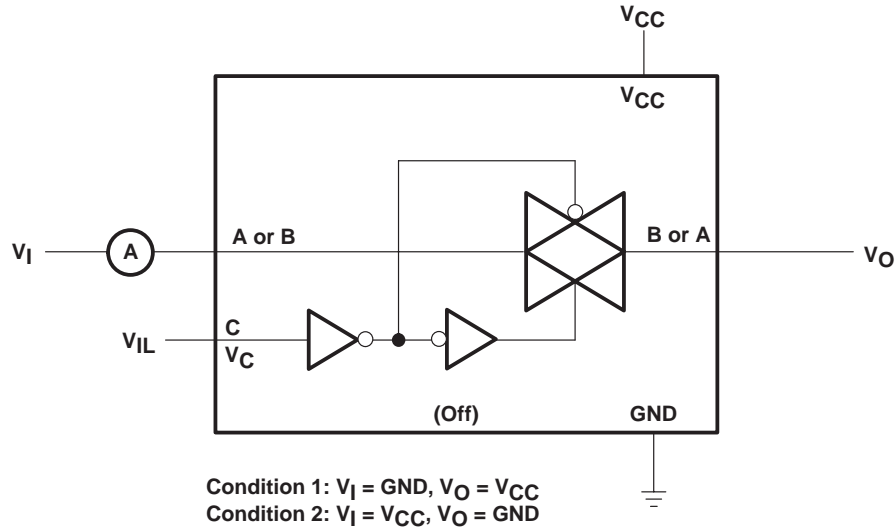
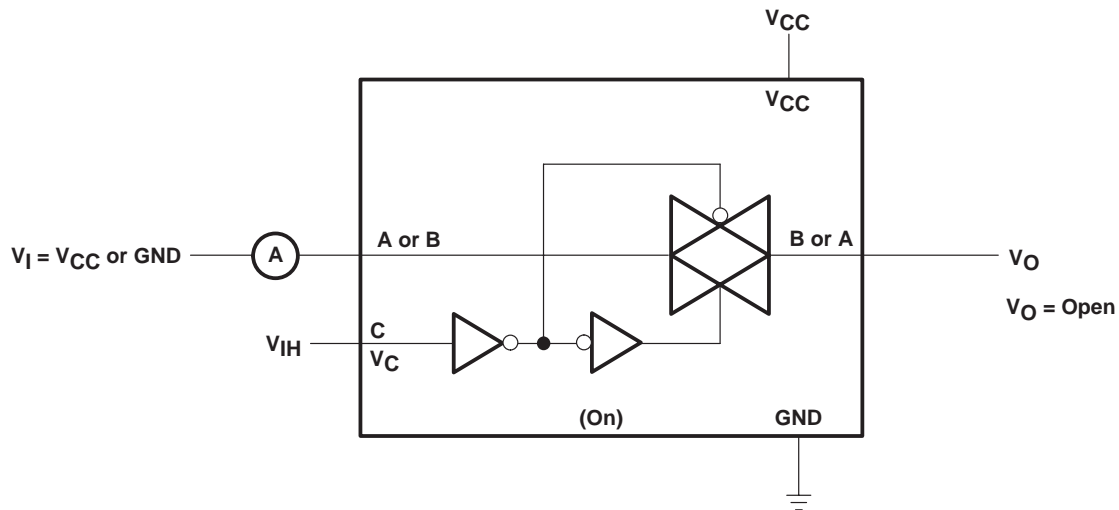


Figure 2. Typical  $r_{on}$  as a Function of Input Voltage ( $V_I$ ) for  $V_I = 0$  to  $V_{CC}$

**PARAMETER MEASUREMENT INFORMATION**



**Figure 3. Off-State Switch Leakage-Current Test Circuit**



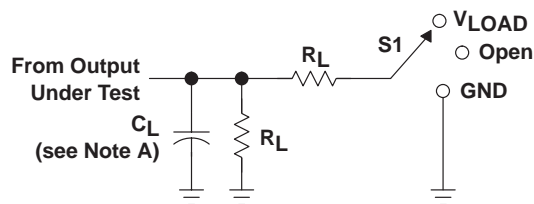
**Figure 4. On-State Leakage-Current Test Circuit**

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## DUAL BILATERAL ANALOG SWITCH

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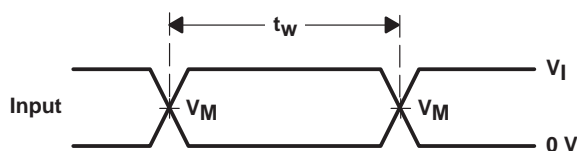
### PARAMETER MEASUREMENT INFORMATION



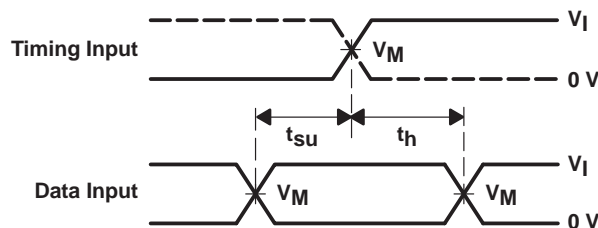
LOAD CIRCUIT

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

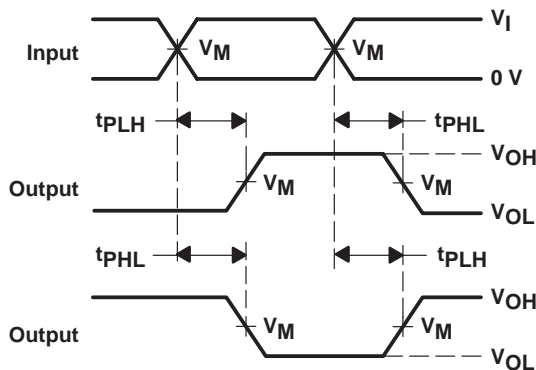
$V_{CC}$	INPUTS		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
$1.8\text{ V} \pm 0.15\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
$3.3\text{ V} \pm 0.3\text{ V}$	$V_{CC}$	$\leq 2.5\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 $\Omega$	0.3 V
$5\text{ V} \pm 0.5\text{ V}$	$V_{CC}$	$\leq 2.5\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 $\Omega$	0.3 V



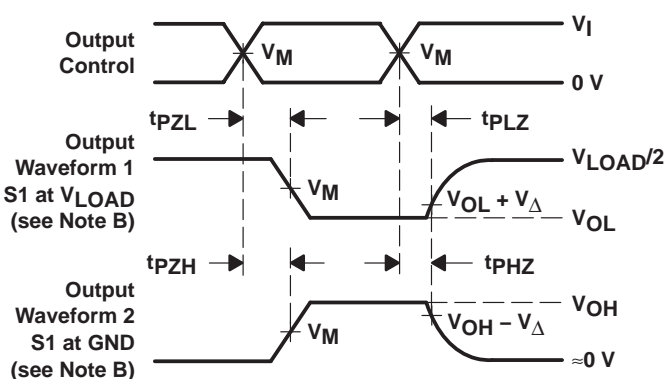
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



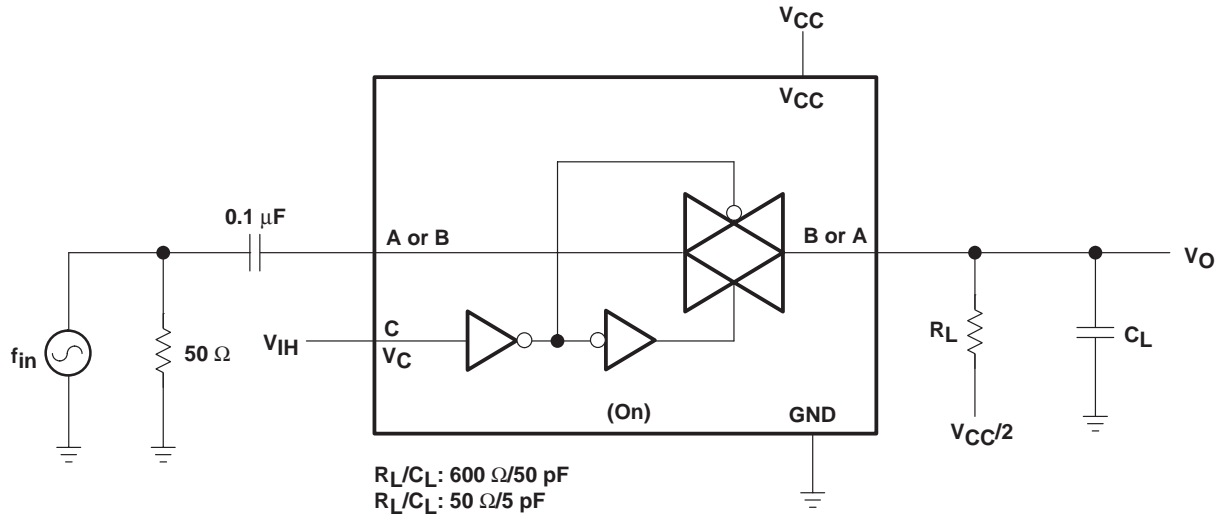
VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- 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:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ .
  - D. The outputs are measured one at a time with one 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.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - H. All parameters and waveforms are not applicable to all devices.

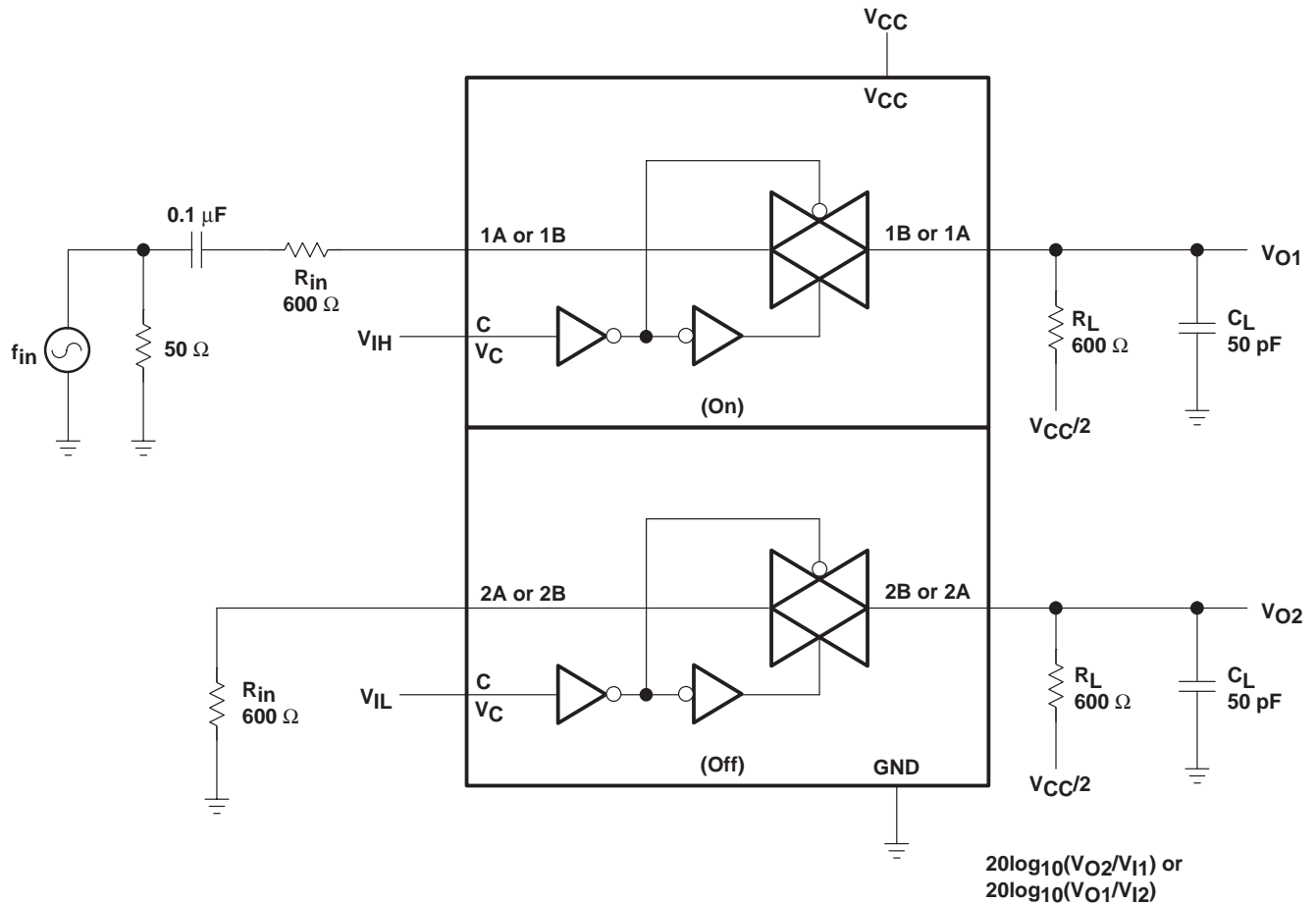
Figure 5. Load Circuit and Voltage Waveforms



**PARAMETER MEASUREMENT INFORMATION**



**Figure 6. Frequency Response (Switch On)**



**Figure 7. Crosstalk (Between Switches)**

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## DUAL BILATERAL ANALOG SWITCH

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### PARAMETER MEASUREMENT INFORMATION

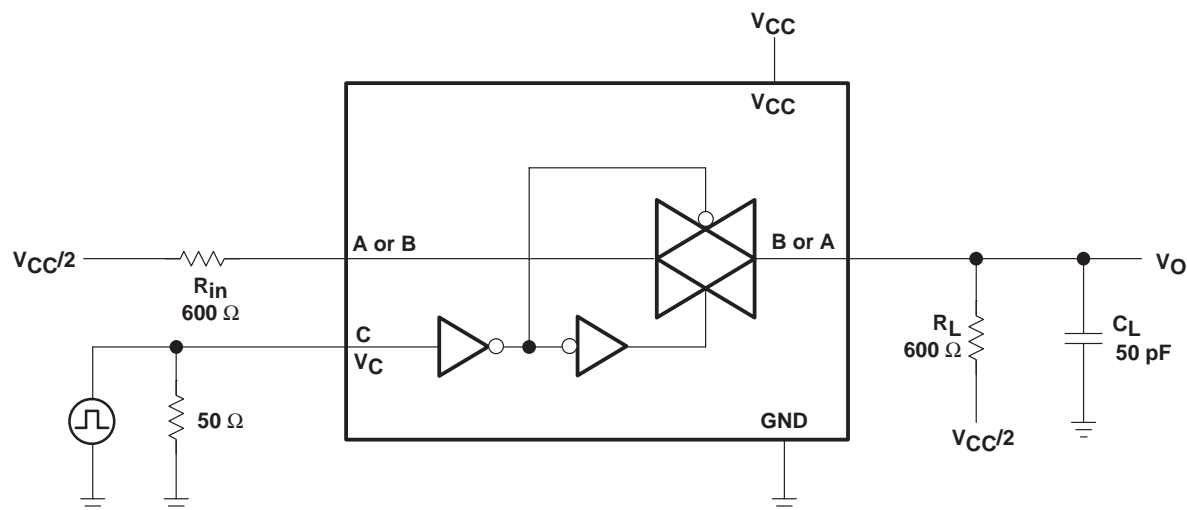


Figure 8. Crosstalk (Control Input, Switch Output)

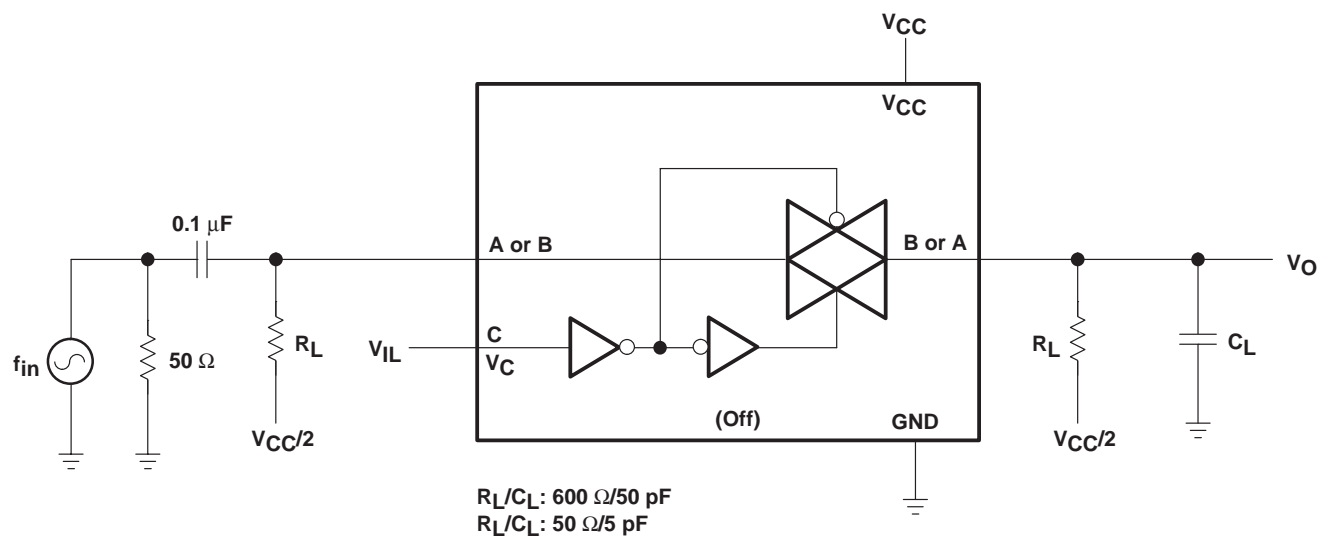
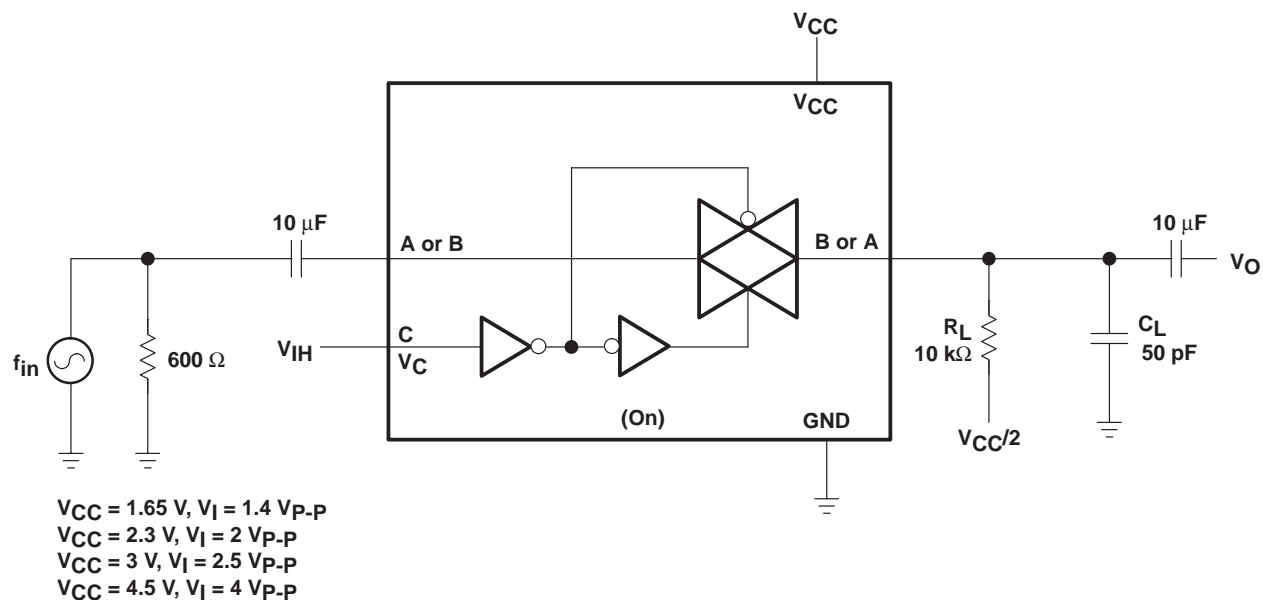


Figure 9. Feed Through (Switch Off)

**PARAMETER MEASUREMENT INFORMATION**



**Figure 10. Sine-Wave Distortion**

## DCT (R-PDSO-G8)

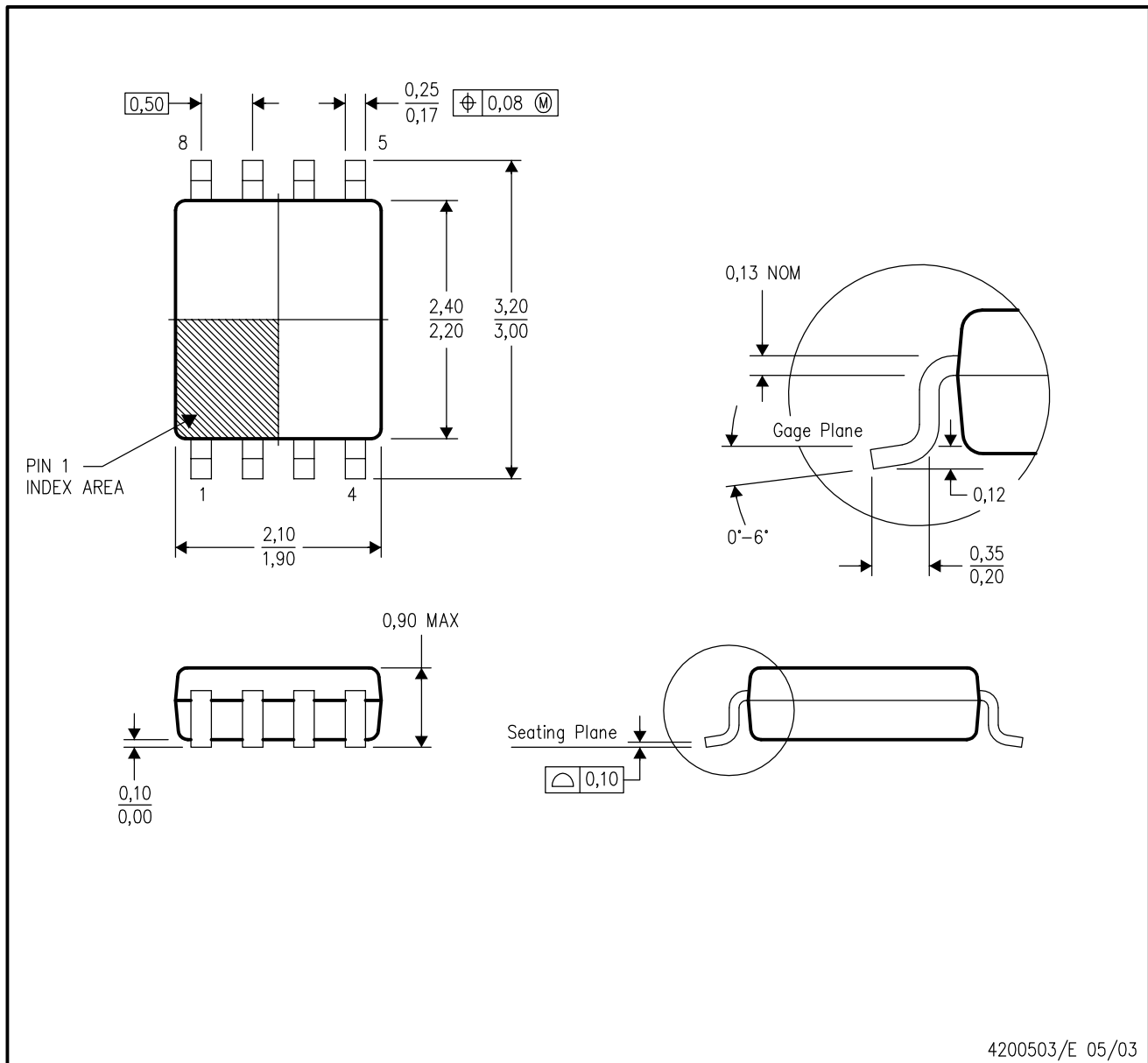
## PLASTIC SMALL-OUTLINE PACKAGE



- 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
  - D. Falls within JEDEC MO-187 variation DA.

DCU (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)

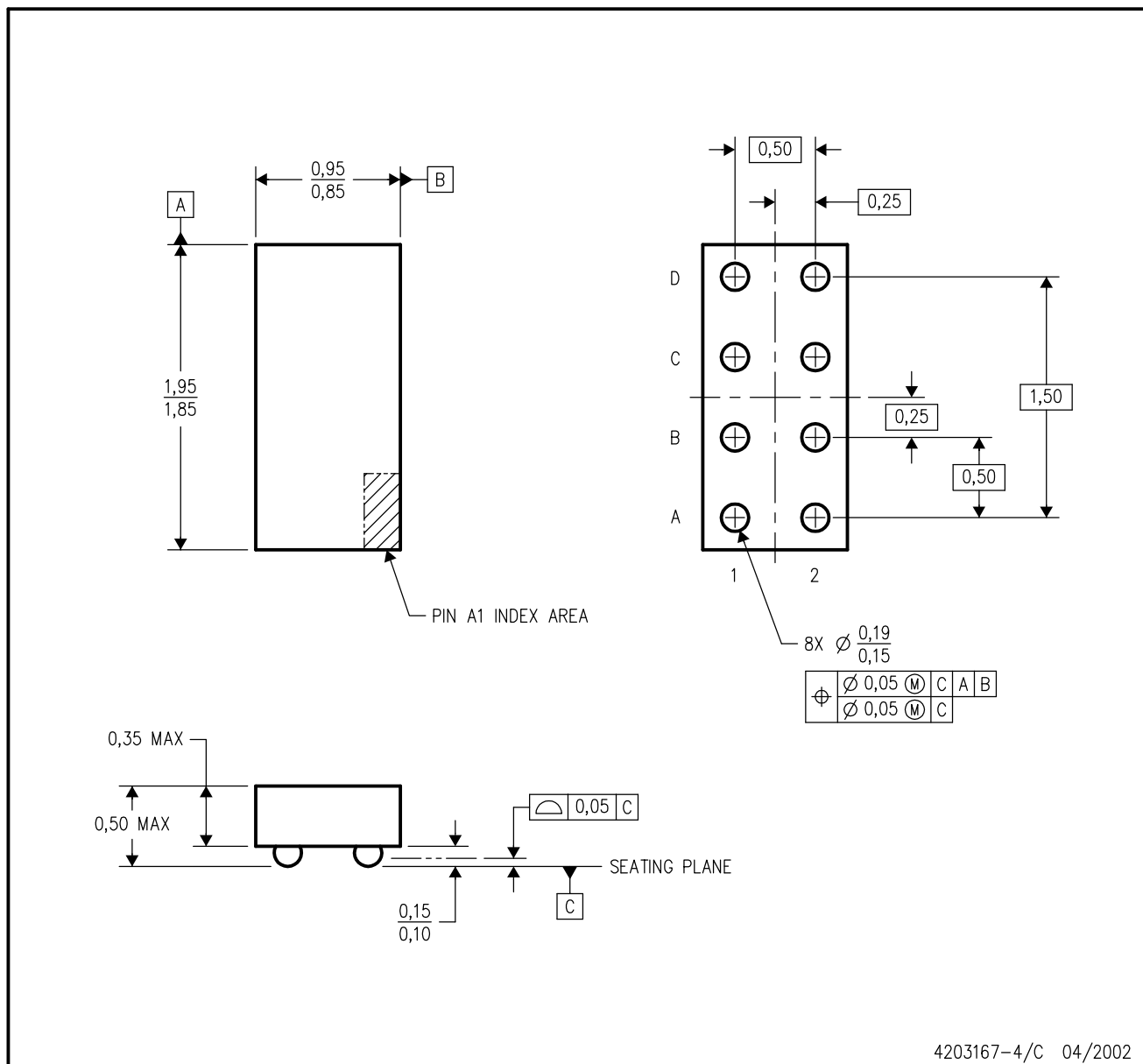


4200503/E 05/03

- 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.
  - D. Falls within JEDEC MO-187 variation CA.

## YEA (R-XBGA-N8)

## DIE-SIZE BALL GRID ARRAY

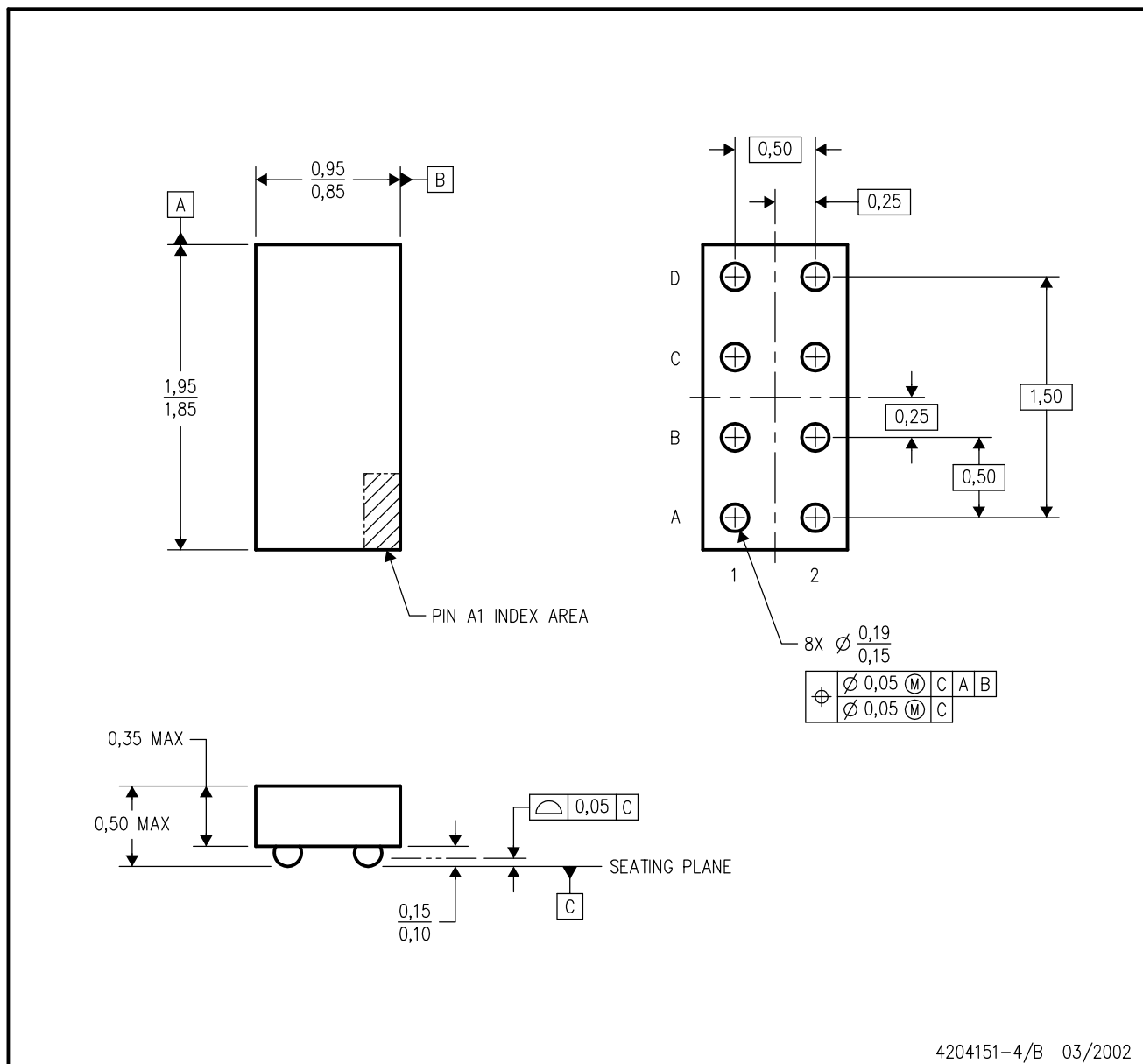


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoStar™ package configuration.
  - D. Package complies to JEDEC MO-211 variation EB.
  - E. This package is tin-lead (SnPb). Refer to the 8 YZA package (drawing 4204151) for lead-free.

NanoStar is a trademark of Texas Instruments.

## YZA (R-XBGA-N8)

## DIE-SIZE BALL GRID ARRAY

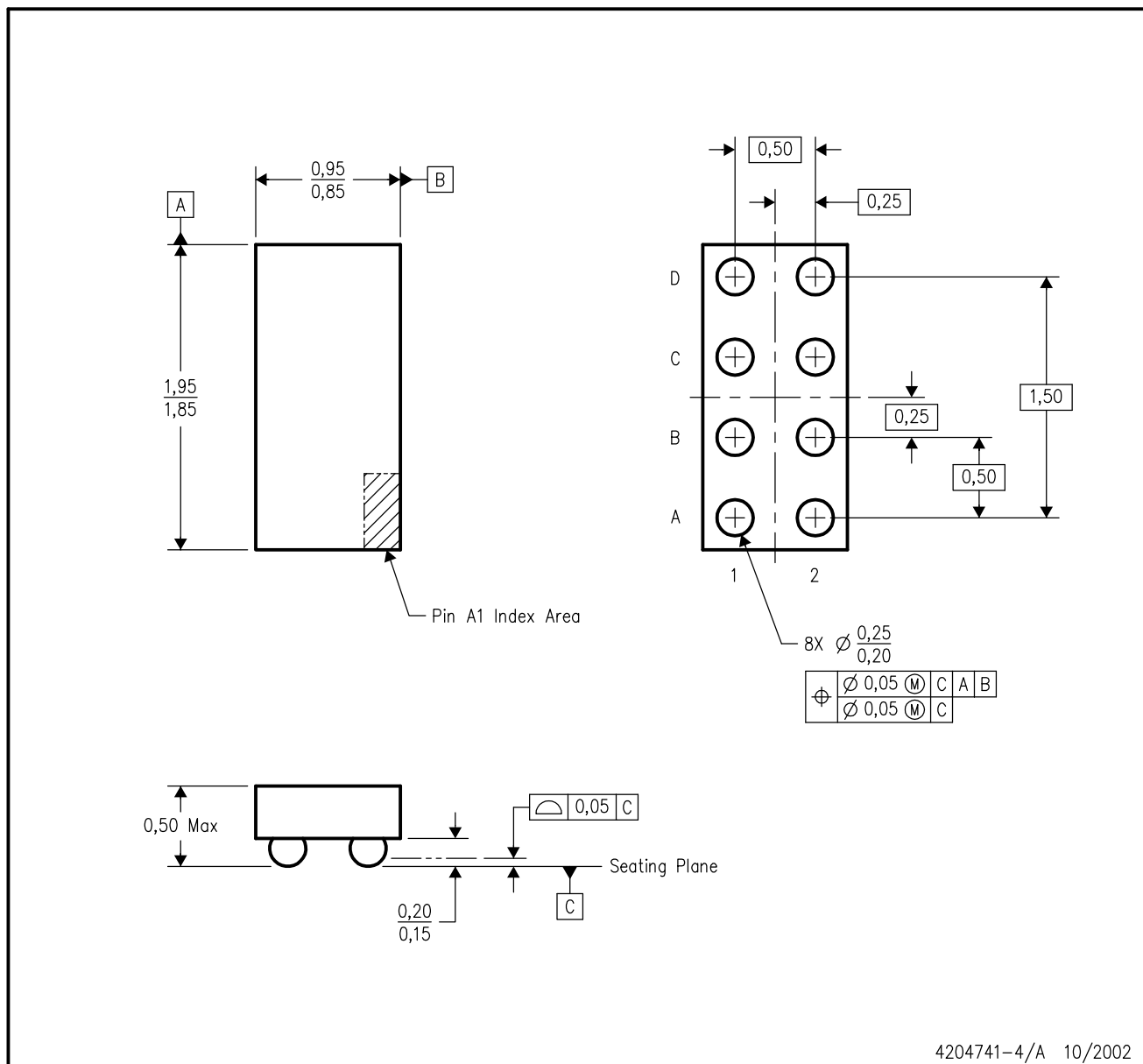


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.
  - D. Package complies to JEDEC MO-211 variation EB.
  - E. This package is lead-free. Refer to the 8 YEA package (drawing 4203167) for tin-lead (SnPb).

NanoFree is a trademark of Texas Instruments.

## YZP (R-XBGA-N8)

## DIE-SIZE BALL GRID ARRAY



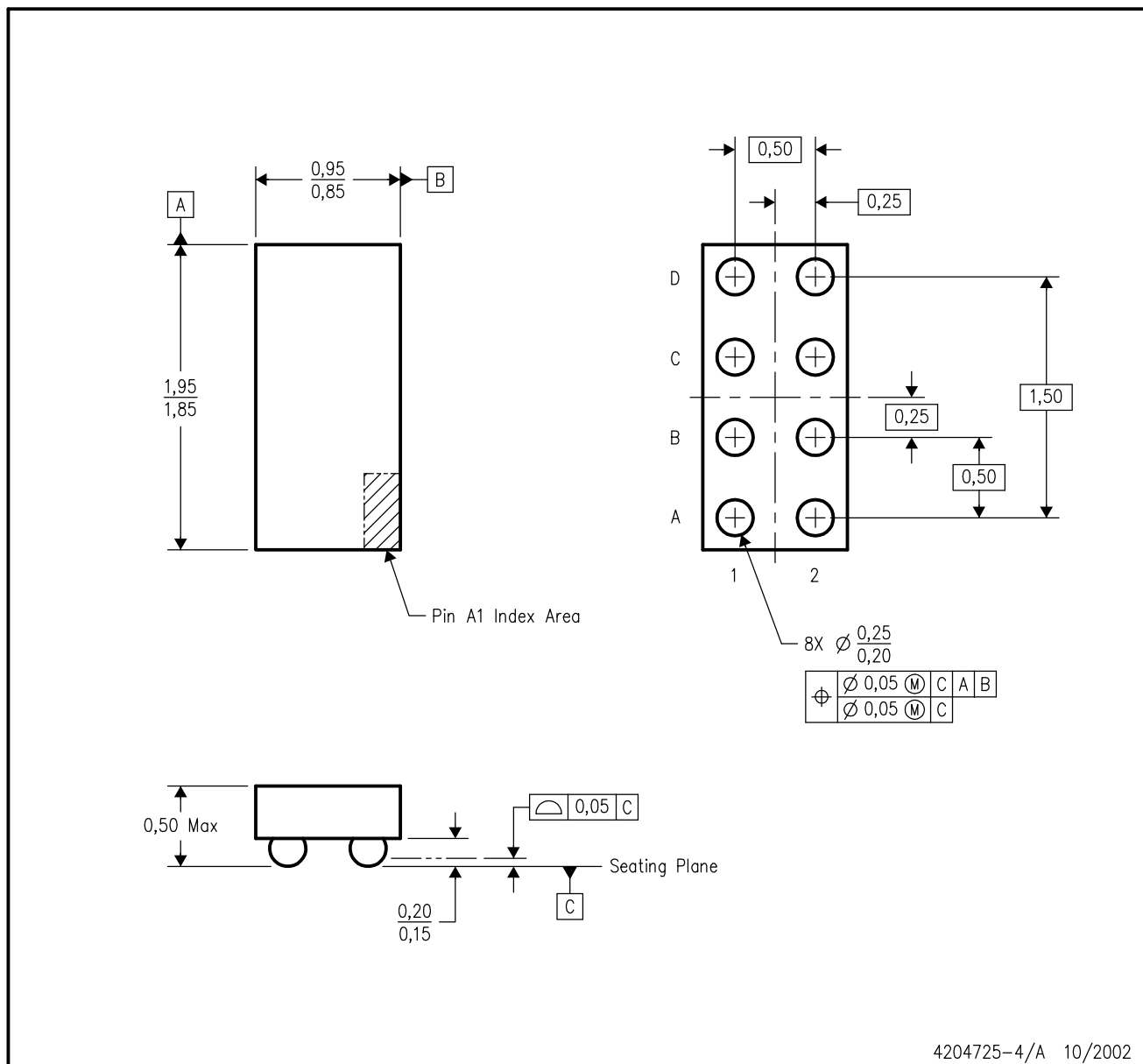
- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.
  - D. This package is lead-free. Refer to the 8 YEP package (drawing 4204725) for tin-lead (SnPb).

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YEP (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoStar™ package configuration.
  - D. This package is tin-lead (SnPb). Refer to the 8 YZP package (drawing 4204741) for lead-free.

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Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265

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