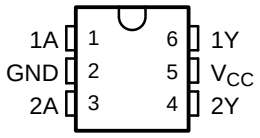
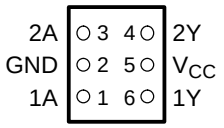
FEATURES

- **Available in the Texas Instruments NanoStar™ and NanoFree™ Packages**
- **Supports 5-V V_{CC} Operation**
- **Inputs Accept Voltages to 5.5 V**
- **Max t_{pd} of 4.1 ns at 3.3 V**
- **Low Power Consumption, 10-μA Max I_{CC}**
- **±24-mA Output Drive at 3.3 V**
- **Typical V_{OLP} (Output Ground Bounce) <0.8 V at V_{CC} = 3.3 V, T_A = 25°C**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2 V at V_{CC} = 3.3 V, T_A = 25°C**
- **I_{off} Supports Partial-Power-Down Mode Operation**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**
  - **1000-V Charged-Device Model (C101)**

DBV OR DCK PACKAGE
(TOP VIEW)



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



DESCRIPTION/ORDERING INFORMATION

This dual inverter is designed for 1.65-V to 5.5-V V_{CC} operation. The SN74LVC2G04 performs the Boolean function $Y = \overline{A}$.

ORDERING INFORMATION

T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING(2)
–40°C to 85°C	NanoStar™ – WCSP (DSBGA) 0.17-mm Small Bump – YEA	Reel of 3000	SN74LVC2G04YEAR	_ _ _CC_
	NanoFree™ – WCSP (DSBGA) 0.17-mm Small Bump – YZA (Pb-free)		SN74LVC2G04YZAR	
	NanoStar™ – WCSP (DSBGA) 0.23-mm Large Bump – YEP		SN74LVC2G04YEPR	
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)		SN74LVC2G04YZPR	
	SOT (SOT-23) – DBV	Reel of 3000	SN74LVC2G04DBVR	C04_
		Reel of 250	SN74LVC2G04DBVT	
	SOT (SC-70) – DCK	Reel of 3000	SN74LVC2G04DCKR	CC_
		Reel of 250	SN74LVC2G04DCKT	

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

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

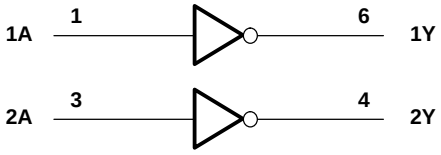
NanoStar™ and NanoFree™ package technology is a major breakthrough in IC packaging concepts, using the die as the package.

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.

FUNCTION TABLE (EACH INVERTER)

INPUT A	OUTPUT Y
H	L
L	H

LOGIC DIAGRAM (POSITIVE LOGIC)



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)	DBV package		165	°C/W
		DCK package		259	
		YEA/YZA package		143	
		YEP/YZP package		123	
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	5.5	V
		Data retention only	1.5		
V_{IH}	High-level input voltage	V_{CC} = 1.65 V to 1.95 V	$0.65 \times V_{CC}$		V
		V_{CC} = 2.3 V to 2.7 V	1.7		
		V_{CC} = 3 V to 3.6 V	2		
		V_{CC} = 4.5 V to 5.5 V	$0.7 \times V_{CC}$		
V_{IL}	Low-level input voltage	V_{CC} = 1.65 V to 1.95 V		$0.35 \times V_{CC}$	V
		V_{CC} = 2.3 V to 2.7 V		0.7	
		V_{CC} = 3 V to 3.6 V		0.8	
		V_{CC} = 4.5 V to 5.5 V		$0.3 \times V_{CC}$	
V_I	Input voltage		0	5.5	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 1.65 V		–4	mA
		V_{CC} = 2.3 V		–8	
		V_{CC} = 3 V		–16	
				–24	
		V_{CC} = 4.5 V		–32	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4	mA
		V_{CC} = 2.3 V		8	
		V_{CC} = 3 V		16	
				24	
		V_{CC} = 4.5 V		32	
$\Delta t/\Delta v$	Input transition rise or fall rate	V_{CC} = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V		20	ns/V
		V_{CC} = 3.3 V ± 0.3 V		10	
		V_{CC} = 5 V ± 0.5 V		5	
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.

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 5.5 V	V_{CC} – 0.1			V
		I_{OH} = –4 mA	1.65 V	1.2			
		I_{OH} = –8 mA	2.3 V	1.9			
		I_{OH} = –16 mA	3 V	2.4			
		I_{OH} = –24 mA		2.3			
		I_{OH} = –32 mA	4.5 V	3.8			
V_{OL}		I_{OL} = 100 µA	1.65 V to 5.5 V			0.1	V
		I_{OL} = 4 mA	1.65 V			0.45	
		I_{OL} = 8 mA	2.3 V			0.3	
		I_{OL} = 16 mA	3 V			0.4	
		I_{OL} = 24 mA				0.55	
		I_{OL} = 32 mA	4.5 V			0.55	
I_I	A inputs	V_I = 5.5 V or GND	0 to 5.5 V			±5	µA
I_{off}		V_I or V_O = 5.5 V	0			±10	µA
I_{CC}		V_I = 5.5 V or GND, I_O = 0	1.65 V to 5.5 V			10	µA
ΔI_{CC}		One input at V_{CC} – 0.6 V, Other inputs at V_{CC} or GND	3 V to 5.5 V			500	µA
C_i		V_I = V_{CC} or GND	3.3 V		3.5		pF

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

Switching Characteristics

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

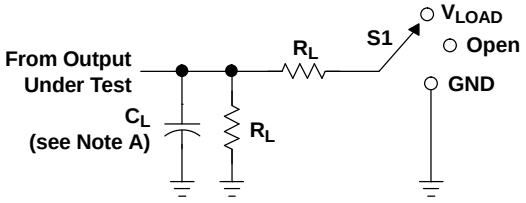
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 1.8 V ± 0.15 V		V_{CC} = 2.5 V ± 0.2 V		V_{CC} = 3.3 V ± 0.3 V		V_{CC} = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	Y	3.1	8	1.5	4.4	1.2	4.1	1	3.2	ns

Operating Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC} = 1.8 V	V_{CC} = 2.5 V	V_{CC} = 3.3 V	V_{CC} = 5 V	UNIT
			TYP	TYP	TYP	TYP	
C_{pd}	Power dissipation capacitance	f = 10 MHz	14	14	14	16	pF

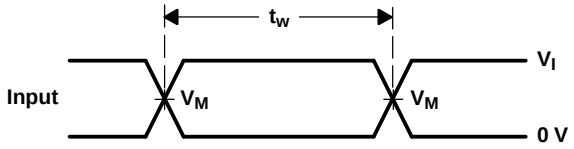
PARAMETER MEASUREMENT INFORMATION



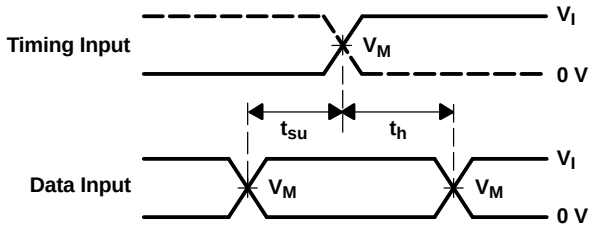
LOAD CIRCUIT

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

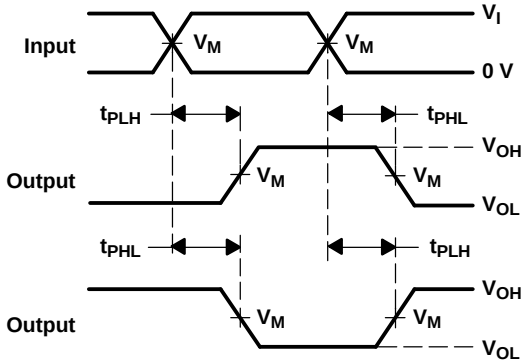
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
1.8 V ± 0.15 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 kΩ	0.15 V
2.5 V ± 0.2 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
3.3 V ± 0.3 V	3 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
5 V ± 0.5 V	V_{CC}	≤2.5 ns	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 Ω	0.3 V



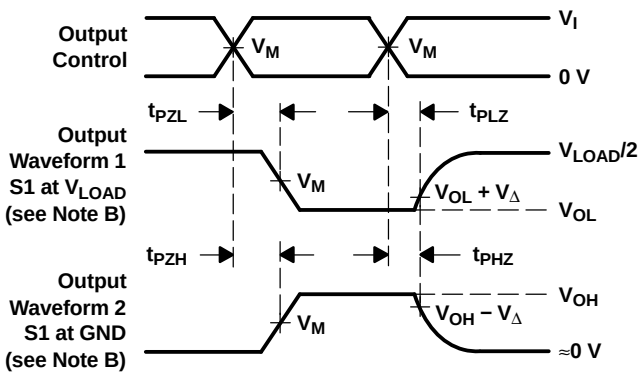
VOLTAGE WAVEFORMS
PULSE DURATION



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: 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 ≤ 10 MHz, Z_O = 50 Ω.
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 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

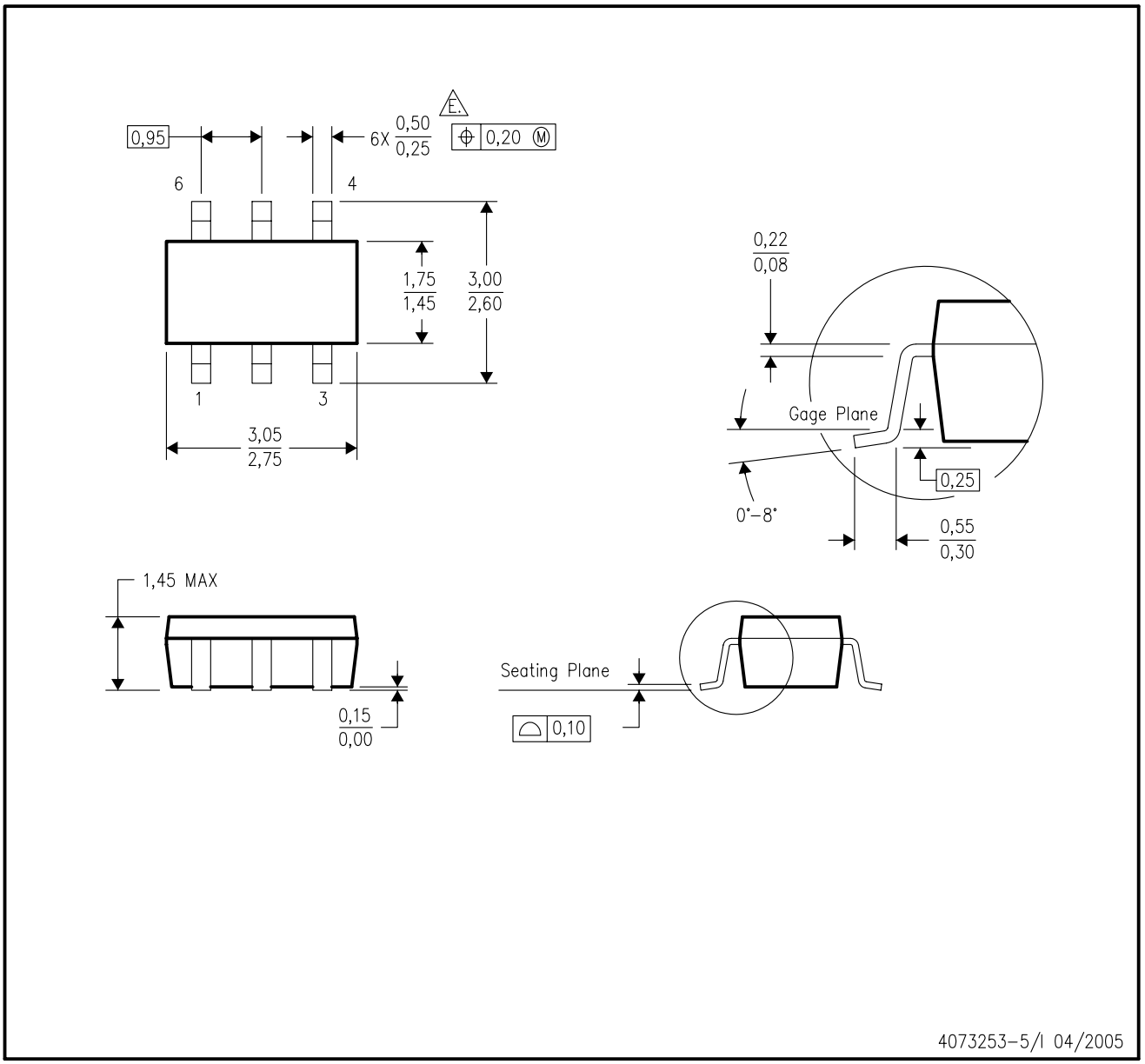
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74LVC2G04DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G04DBVT	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G04DCKR	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G04DCKRE4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G04DCKRG4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G04DCKT	ACTIVE	SC70	DCK	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G04DCKTE4	ACTIVE	SC70	DCK	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G04YEAR	ACTIVE	WCSP	YEA	6	3000	TBD	SNPB	Level-1-260C-UNLIM
SN74LVC2G04YEPR	ACTIVE	WCSP	YEP	6	3000	TBD	SNPB	Level-1-260C-UNLIM
SN74LVC2G04YZAR	ACTIVE	WCSP	YZA	6	3000	Pb-Free (RoHS)	SNAGCU	Level-1-260C-UNLIM
SN74LVC2G04YZPR	ACTIVE	WCSP	YZP	6	3000	Pb-Free (RoHS)	SNAGCU	Level-1-260C-UNLIM

(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) 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.

DBV (R–PDSO–G6) 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. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
E. Falls within JEDEC MO–178 Variation AB, except minimum lead width.

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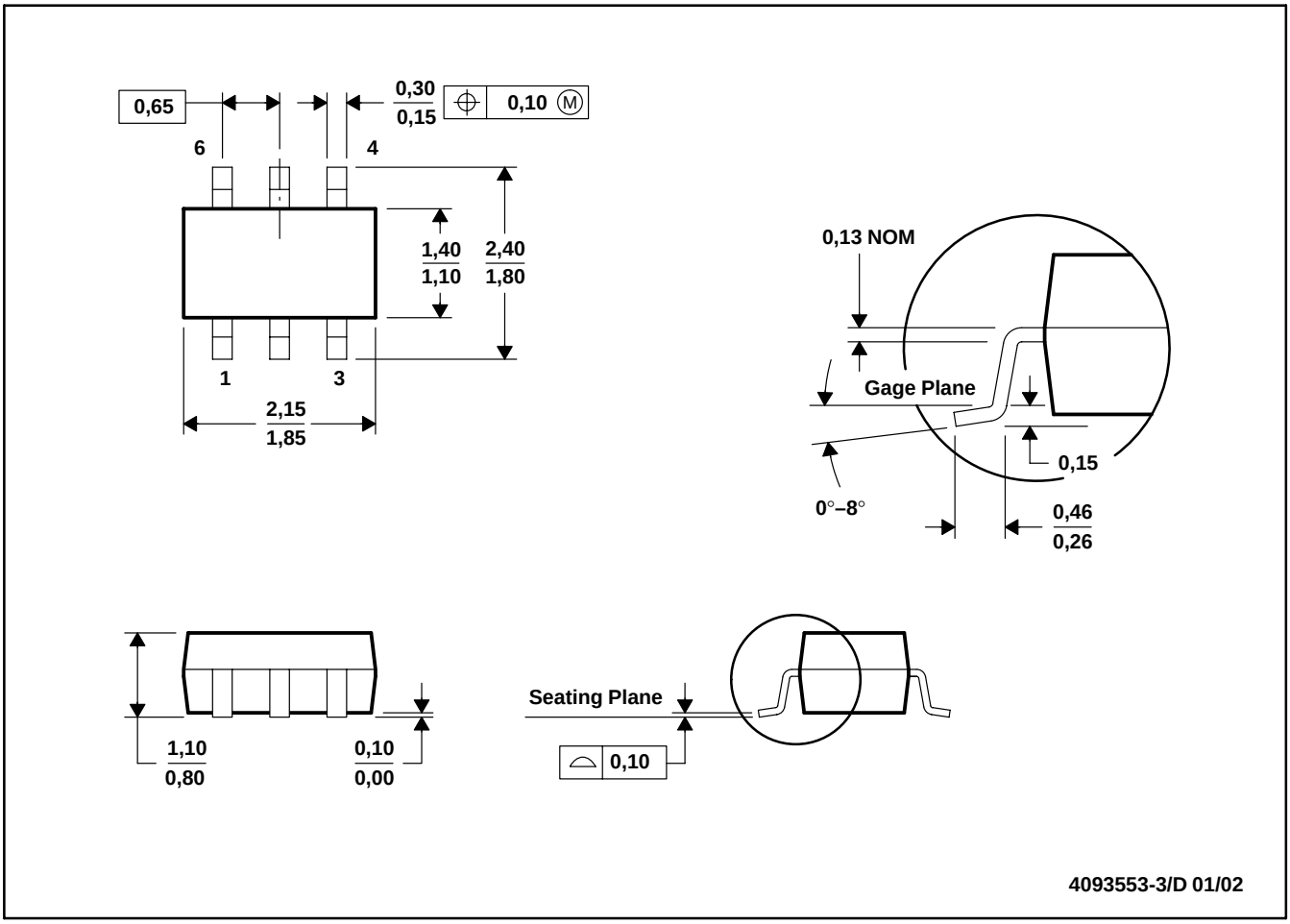
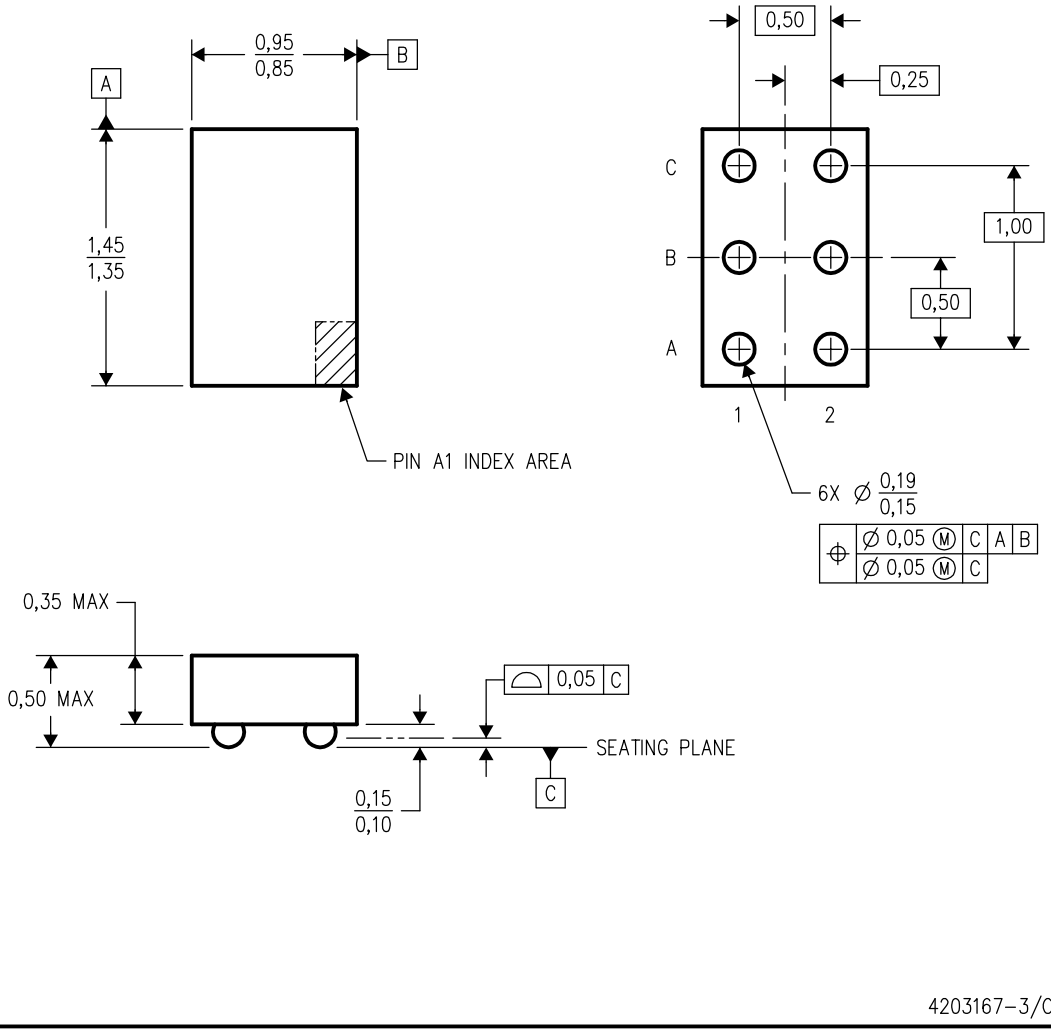
DCK (R-PDSO-G6) **PLASTIC SMALL-OUTLINE PACKAGE**



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-203

YEA (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY

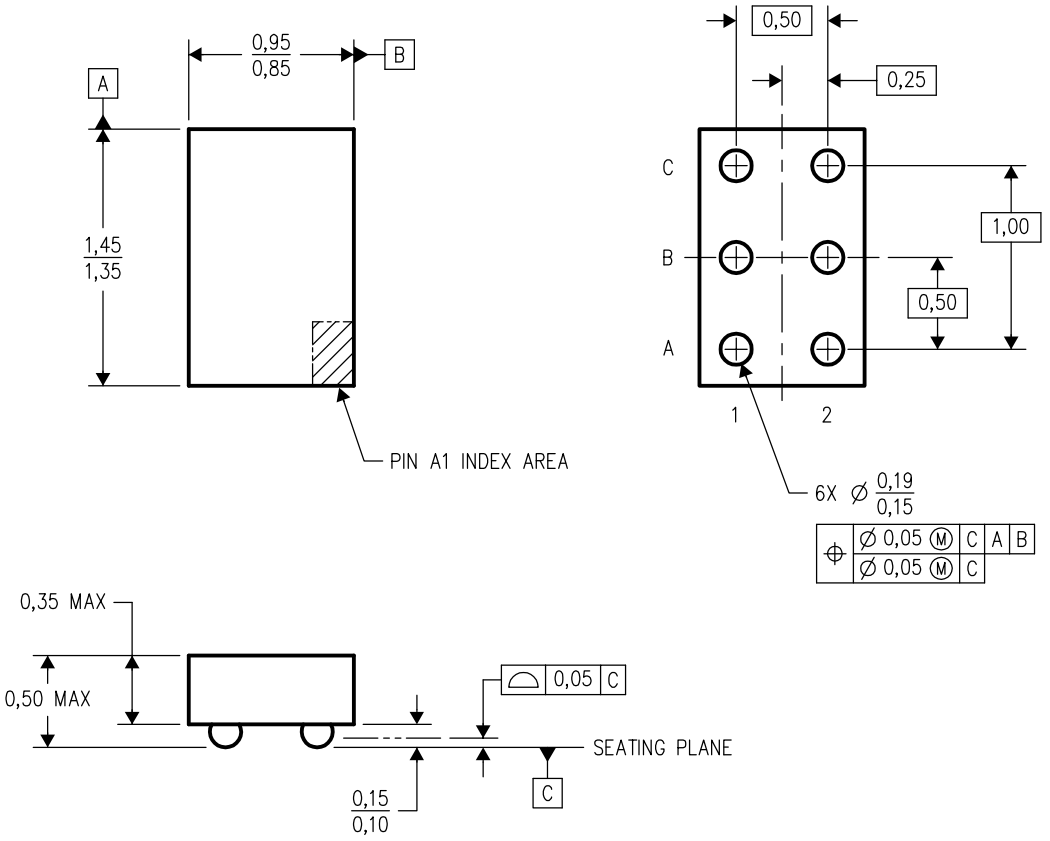


4203167–3/C 04/2002

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 EA.
E. This package is tin–lead (SnPb). Refer to the 6 YZA package (drawing 4204151) for lead–free.

NanoStar is a trademark of Texas Instruments.

YZA (R–XBGA–N6) 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 EA.
E. This package is lead–free. Refer to the 6 YEA package (drawing 4203167) for tin–lead (SnPb).

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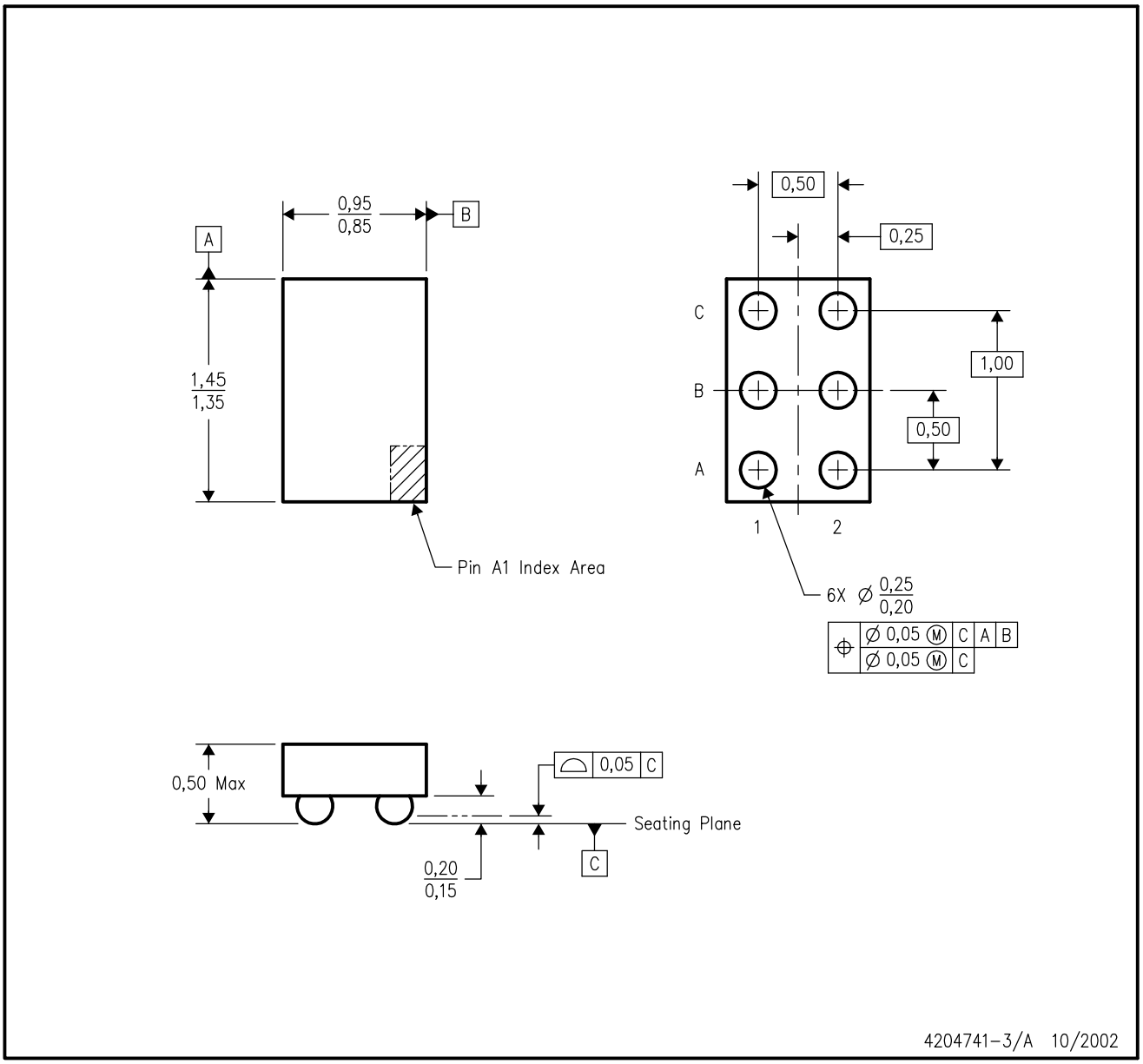
YZP (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY



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 6 YEP package (drawing 4204725) for tin–lead (SnPb).

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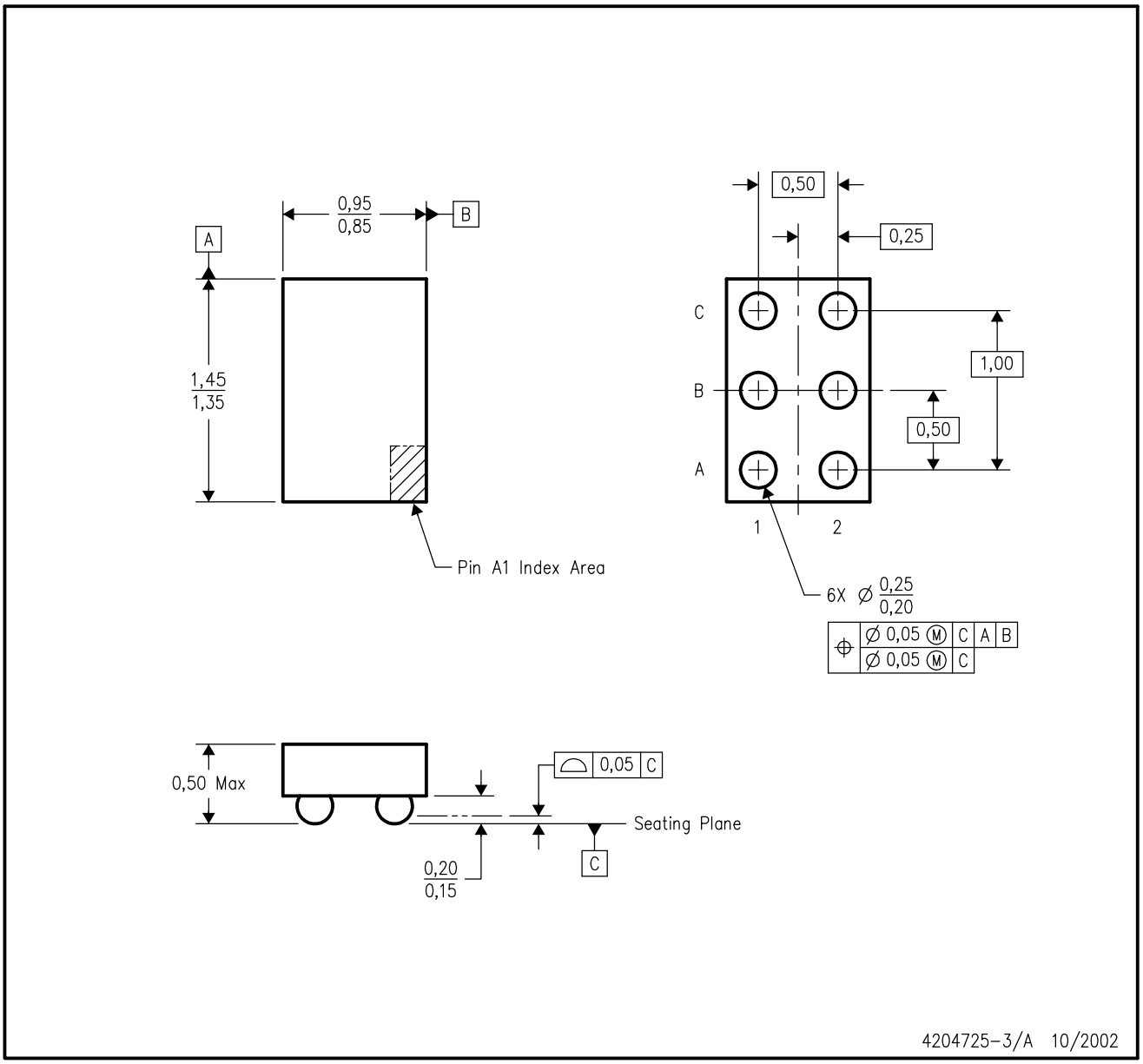
YEP (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY



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 6 YZP package (drawing 4204741) for lead–free.

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