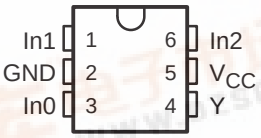
SN74LVC1G57
CONFIGURABLE MULTIPLE-FUNCTION GATE

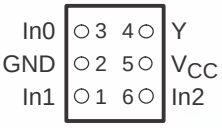
SCES414G – NOVEMBER 2002 – REVISED SEPTEMBER 2003

- **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 6.3 ns at 3.3 V**
- **Low Power Consumption, 10-μA Max I_{CC}**
- **±24-mA Output Drive at 3.3 V**
- **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 configurable multiple-function gate is designed for 1.65-V to 5.5-V V_{CC} operation.

The SN74LVC1G57 features configurable multiple functions. The output state is determined by eight patterns of 3-bit input. The user can choose the logic functions AND, OR, NAND, NOR, XNOR, inverter, and noninverter. All inputs can be connected to V_{CC} or GND.

This device functions as an independent gate, but because of Schmitt action, it may have different input threshold levels for positive-going (V_{T+}) and negative-going (V_{T-}) signals.

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

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	Tape and reel	SN74LVC1G57YEAR	_ _ _CL_
	NanoFree™ – WCSP (DSBGA) 0.17-mm Small Bump − YZA (Pb-free)		SN74LVC1G57YZAR	
	NanoStar™ – WCSP (DSBGA) 0.23-mm Large Bump − YEP		SN74LVC1G57YEPR	
	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump − YZP (Pb-free)		SN74LVC1G57YZPR	
	SOT (SOT-23) − DBV	Tape and reel	SN74LVC1G57DBVR	CA7_
	SOT (SC-70) − DCK	Tape and reel	SN74LVC1G57DCKR	CL_

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

‡ 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).

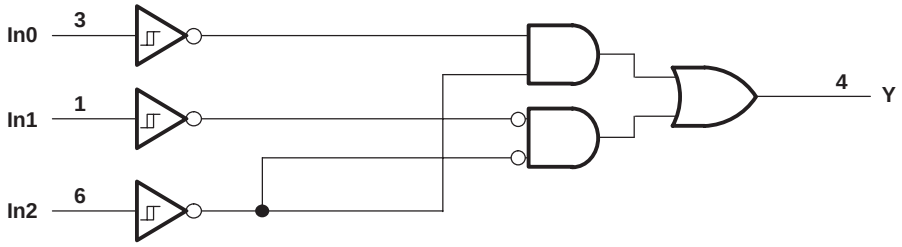
description/ordering information (continued)

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

INPUTS			OUTPUT
In2	In1	In0	Y
L	L	L	H
L	L	H	L
L	H	L	H
L	H	H	L
H	L	L	L
H	L	H	L
H	H	L	H
H	H	H	H

logic diagram (positive logic)



FUNCTION SELECTION TABLE

LOGIC FUNCTION	FIGURE NO.
2-input AND	1
2-input AND with both inputs inverted	4
2-input NAND with inverted input	2, 3
2-input OR with inverted input	2, 3
2-input NOR	4
2-input NOR with both inputs inverted	1
2-input XNOR	5

logic configurations

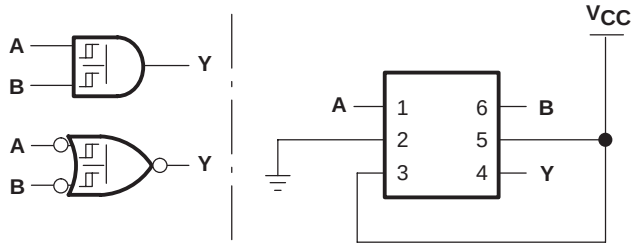


Figure 1. 2-Input AND Gate

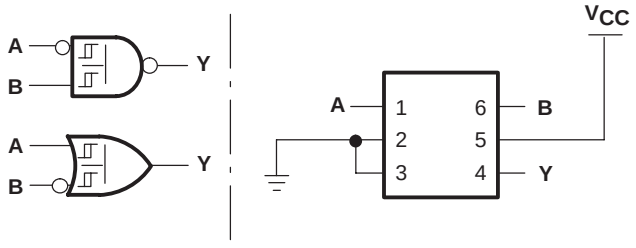


Figure 2. 2-Input NAND Gate With Inverted A Input

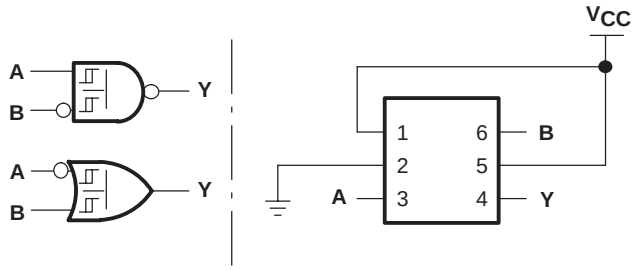


Figure 3. 2-Input NAND Gate With Inverted B Input

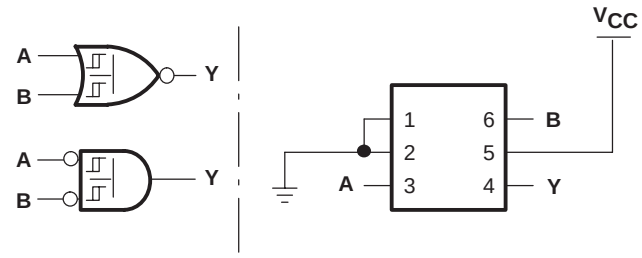


Figure 4. 2-Input NOR Gate

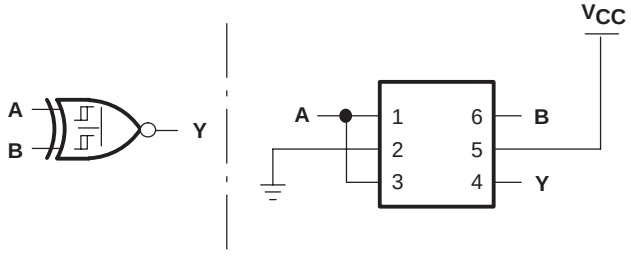


Figure 5. 2-Input XNOR Gate

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

Supply voltage range, V_{CC} . . . . . −0.5 V to 6.5 V
Input voltage range, V_I (see Note 1) . . . . . −0.5 V to 6.5 V
Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1) . . . . . −0.5 V to 6.5 V
Voltage range applied to any output 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) . . . . . −50 mA
Output clamp current, I_{OK} (V_O < 0) . . . . . −50 mA
Continuous output current, I_O . . . . . ±50 mA
Continuous current through V_{CC} or GND . . . . . ±100 mA
Package thermal impedance, θ_{JA} (see Note 3): DBV package . . . . . 165°C/W
DCK package . . . . . 259°C/W
YEA/YZA package . . . . . 143°C/W
YEP/YZP package . . . . . 123°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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The value of V_{CC} is provided in the recommended operating conditions table.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V_{CC}	Supply voltage	Operating	1.65	5.5	V
		Data retention only	1.5		
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	
T_A	Operating free-air temperature		−40	85	°C

NOTE 4: 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†	MAX	UNIT
V_{T+} Positive-going input threshold voltage			1.65 V	0.79		1.16	V
			2.3 V	1.11		1.56	
			3 V	1.5		1.87	
			4.5 V	2.16		2.74	
			5.5 V	2.61		3.33	
V_{T-} Negative-going input threshold voltage			1.65 V	0.39		0.62	V
			2.3 V	0.58		0.87	
			3 V	0.84		1.14	
			4.5 V	1.41		1.79	
			5.5 V	1.87		2.29	
ΔV_T Hysteresis ($V_{T+} - V_{T-}$)			1.65 V	0.37		0.62	V
			2.3 V	0.48		0.77	
			3 V	0.56		0.87	
			4.5 V	0.71		1.04	
			5.5 V	0.71		1.11	
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	V_I = 5.5 V or GND		0 to 5.5 V			±1	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

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

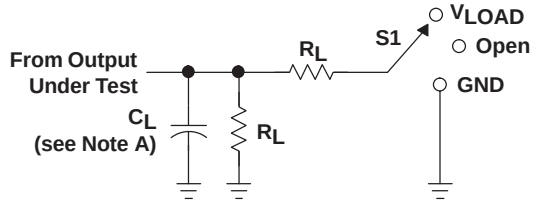
switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 6)

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}	Any In	Y	3.2	14.4	2	8.3	1.5	6.3	1.1	5.1	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	20	20	21	22	pF

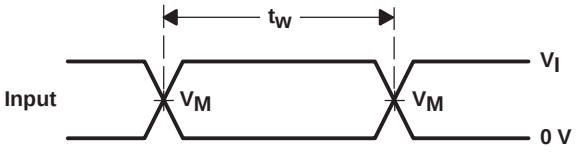
PARAMETER MEASUREMENT INFORMATION



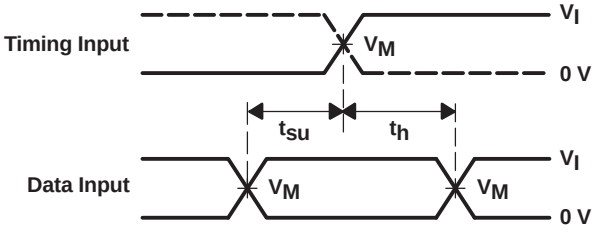
LOAD CIRCUIT

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

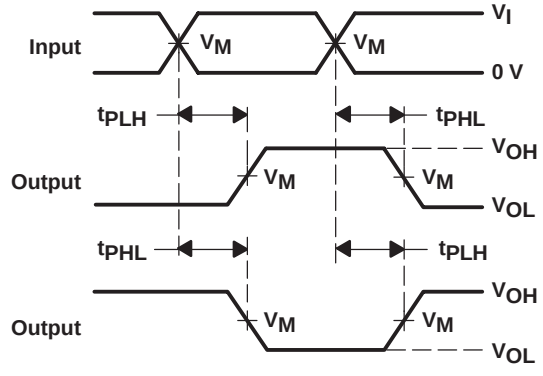
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
1.8 V ± 0.15 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 kΩ	0.15 V
2.5 V ± 0.2 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
3.3 V ± 0.3 V	3 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
5 V ± 0.5 V	V_{CC}	≤2.5 ns	$V_{CC}/2$	$2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



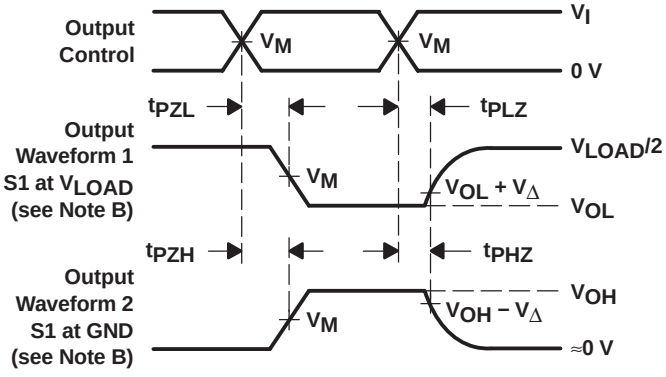
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS

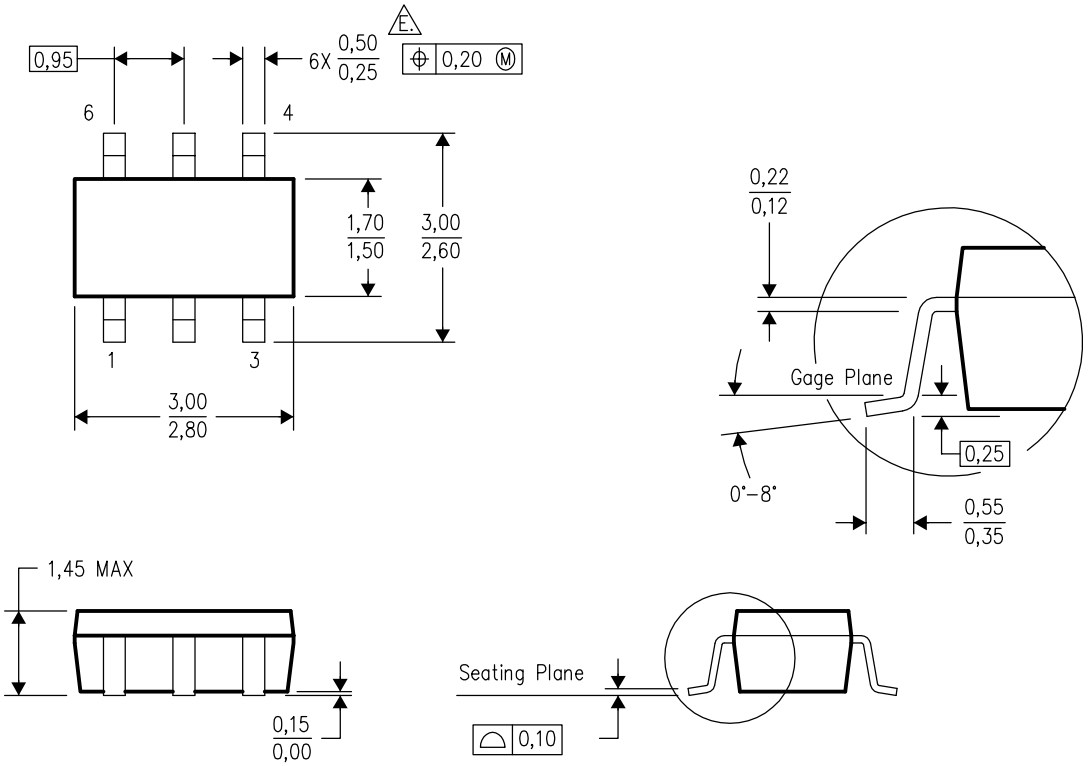


VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

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 6. Load Circuit and Voltage Waveforms

DBV (R–PDSO–G6) PLASTIC SMALL–OUTLINE PACKAGE

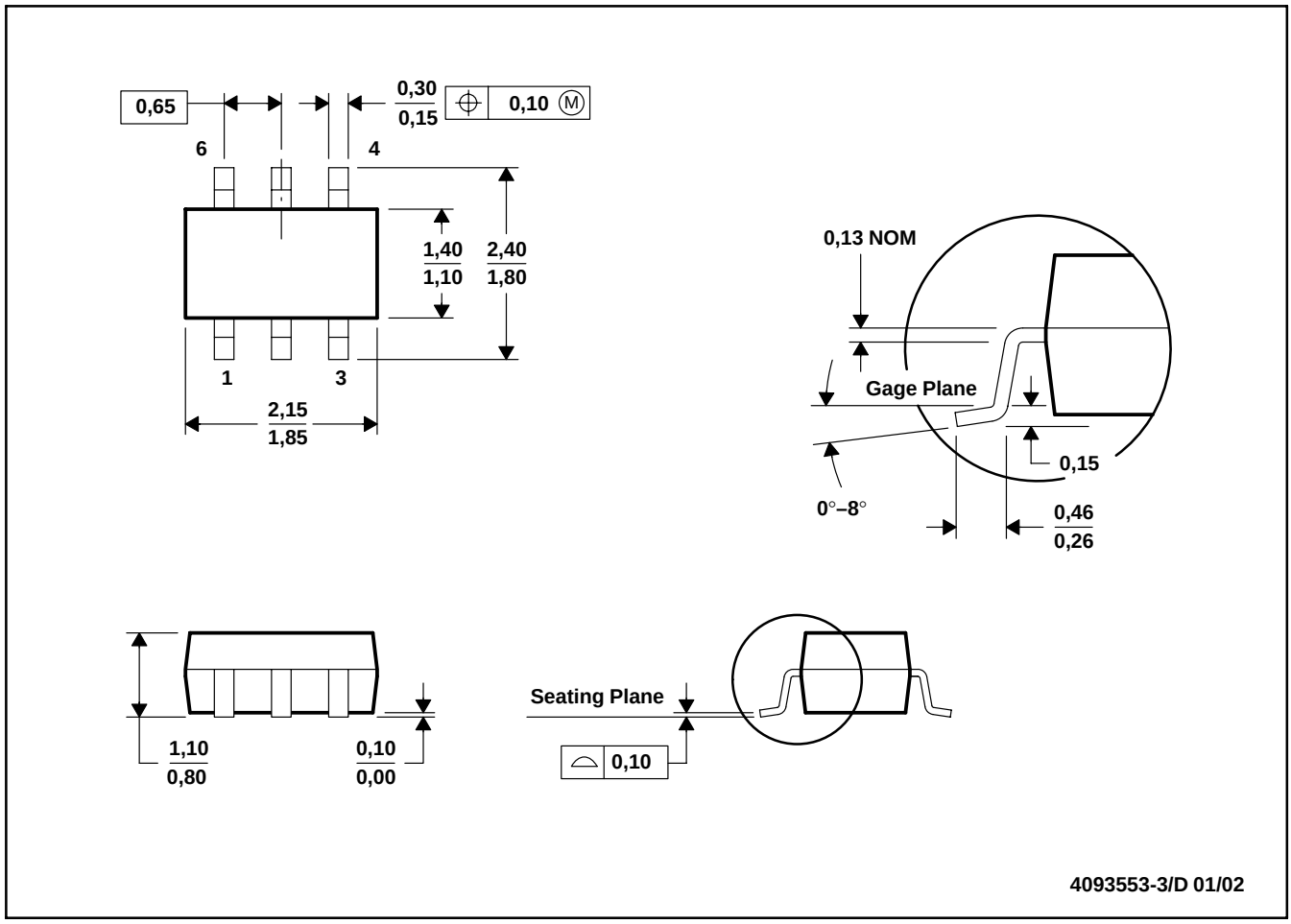


4073253–5/H 10/2003

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.

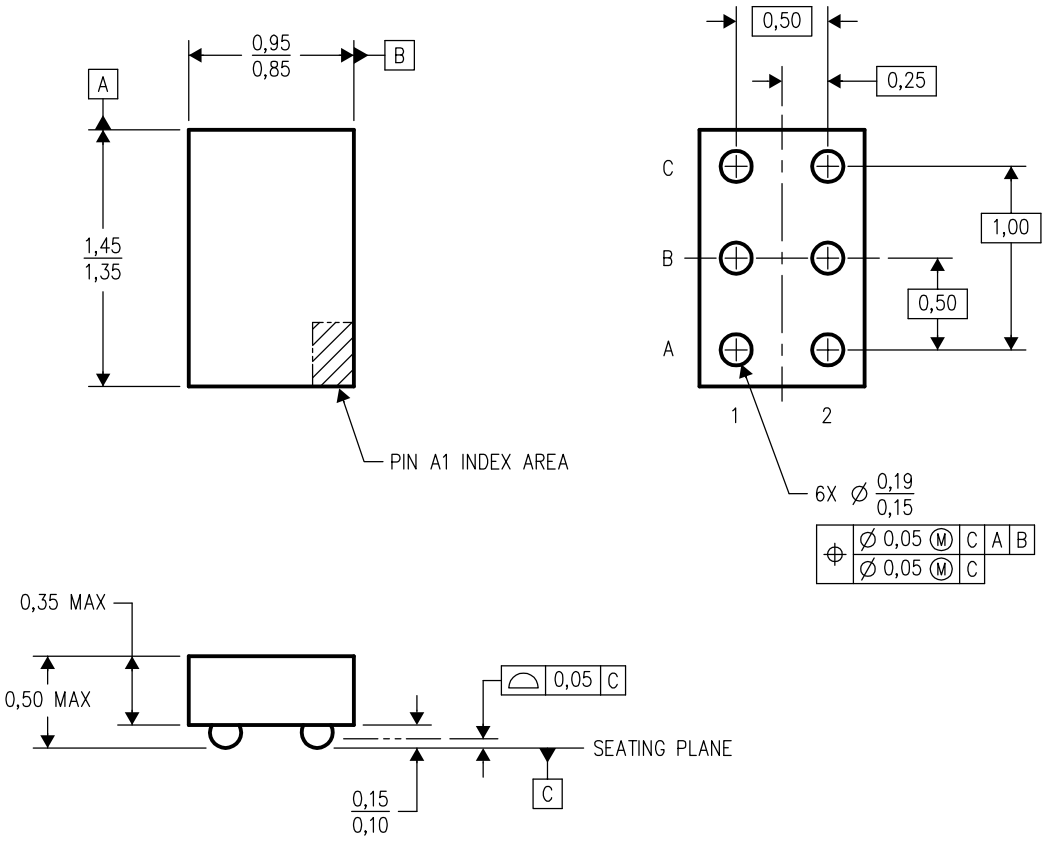
MPDS114 – FEBRUARY 2002

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

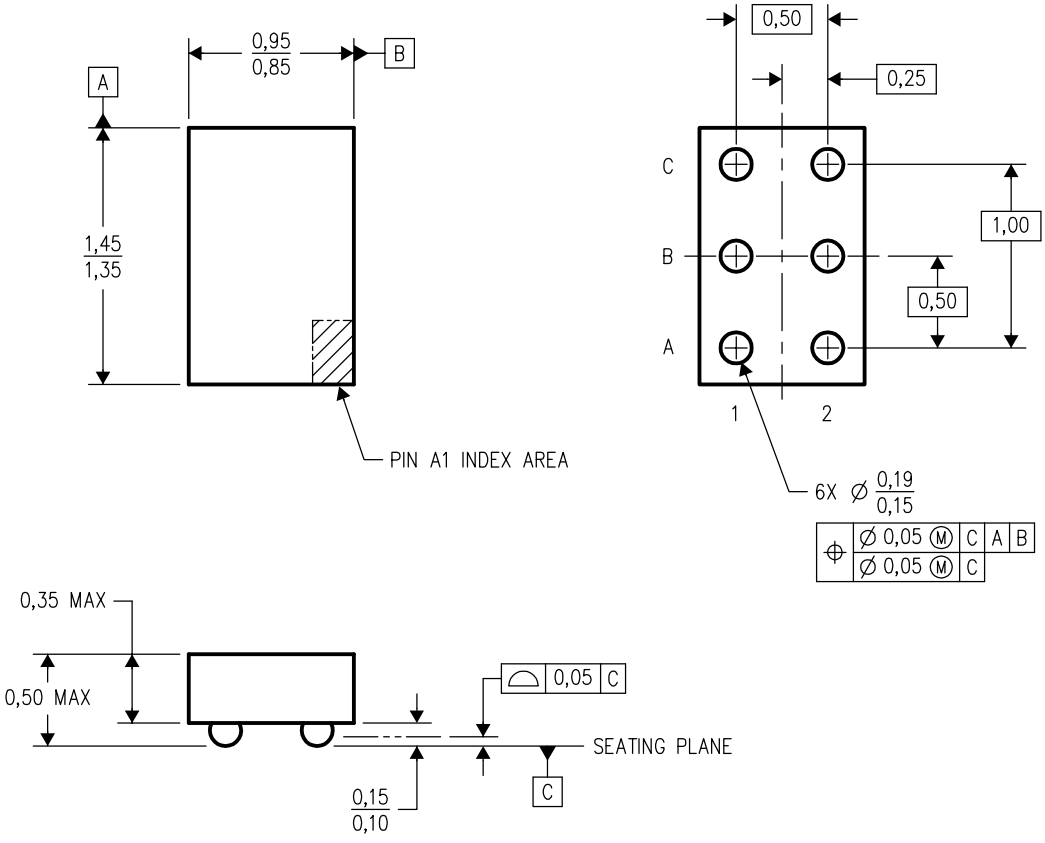


4203167–3/C 04/2002

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



4204151–3/B 03/2002

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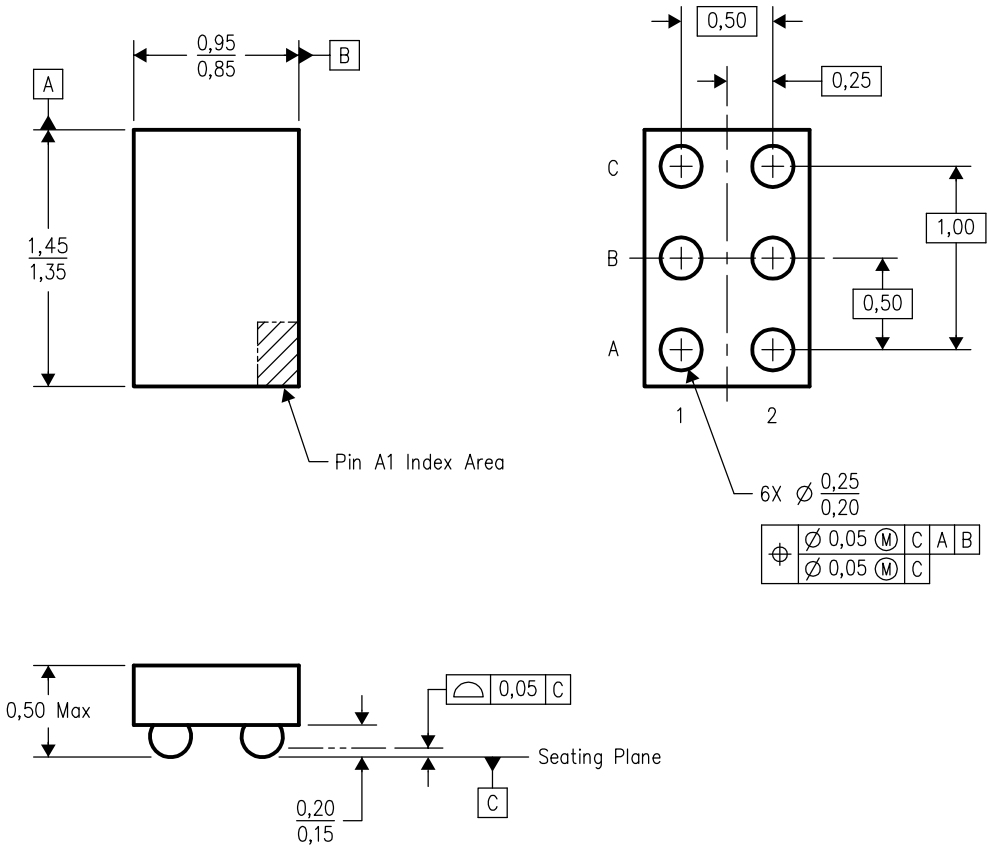
YZP (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY



4204741–3/A 10/2002

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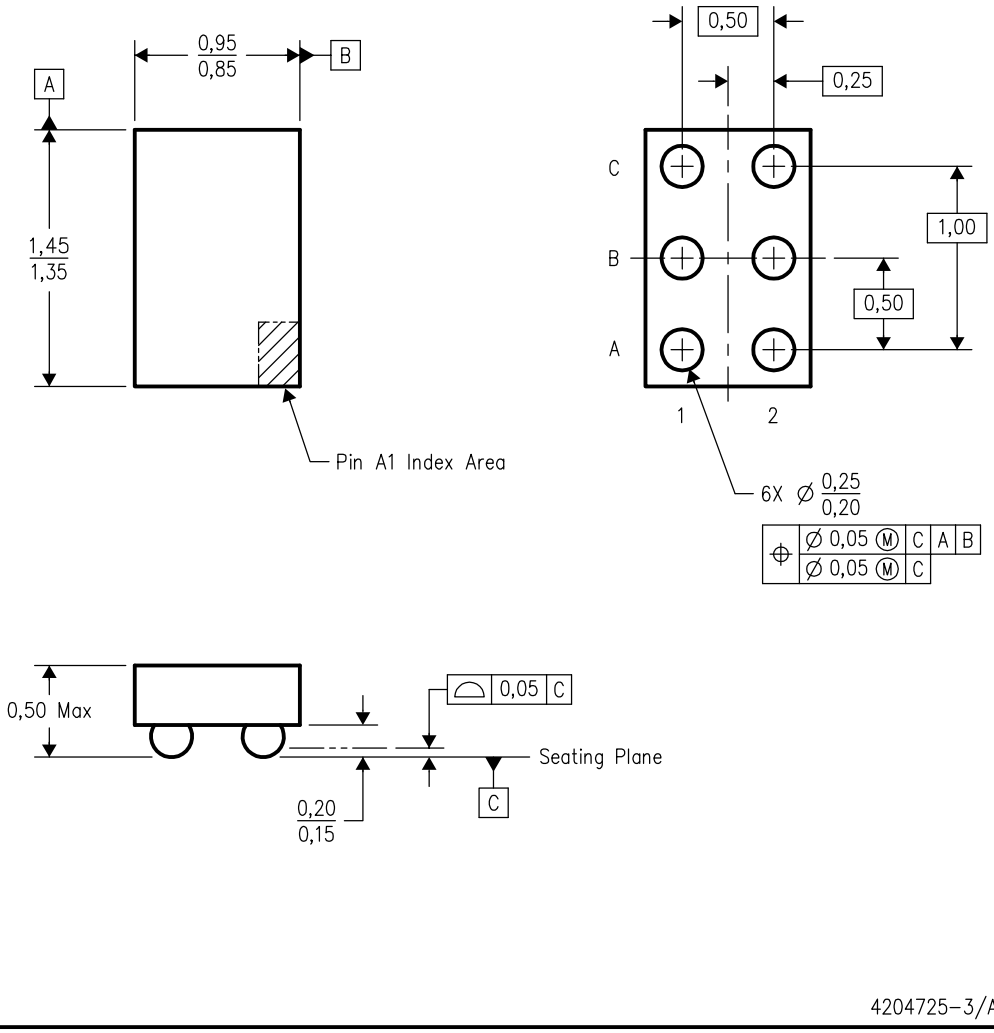
YEP (R–XBGA–N6) DIE–SIZE BALL GRID ARRAY



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