

SN74LVC244A OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

SCAS414U – NOVEMBER 1992 – REVISED AUGUST 2003

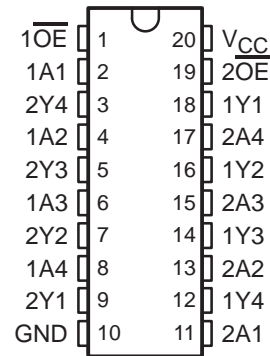
- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max t_{pd} of 5.9 ns at 3.3 V
- Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot) >2 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V V_{CC})
- 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)

description/ordering information

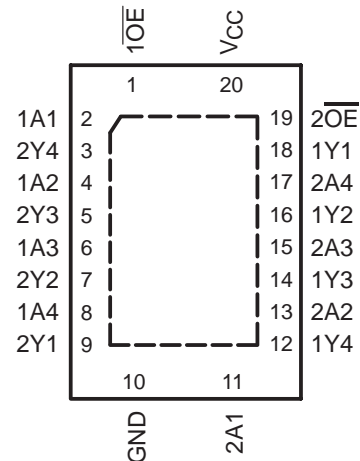
This octal buffer/line driver is operational at 1.5-V to 3.6-V V_{CC} , but is designed specifically for 1.65-V to 3.6-V V_{CC} operation.

The SN74LVC244A is organized as two 4-bit line drivers with separate output-enable (\overline{OE}) inputs. When \overline{OE} is low, the device passes data from the A inputs to the Y outputs. When \overline{OE} is high, the outputs are in the high-impedance state.

DB, DGV, DW, N, NS, OR PW PACKAGE
(TOP VIEW)



RGY PACKAGE
(TOP VIEW)



ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP – N	Tube of 20	SN74LVC244AN	SN74LVC244AN
	QFN – RGY	Reel of 1000	SN74LVC244ARGYR	LC244A
	SOIC – DW	Tube of 25	SN74LVC244ADW	LVC244A
		Reel of 2000	SN74LVC244ADWR	
	SOP – NS	Reel of 2000	SN74LVC244ANSR	LVC244A
	SSOP – DB	Reel of 2000	SN74LVC244ADBR	LC244A
	TSSOP – PW	Tube of 70	SN74LVC244APW	LC244A
		Reel of 2000	SN74LVC244APWR	
		Reel of 250	SN74LVC244APWT	
	TVSOP – DGV	Reel of 2000	SN74LVC244ADGVR	LC244A
VFBGA – GQN	Reel of 1000	SN74LVC244AGQNR	LC244A	
VFBGA – ZQN (Pb-Free)		SN74LVC244AZQNR		

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

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.



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.

 **TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2003, Texas Instruments Incorporated

SN74LVC244A OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

SCAS414U – NOVEMBER 1992 – REVISED AUGUST 2003

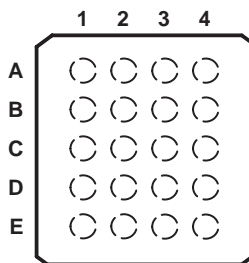
description/ordering information (continued)

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of this device as a translator in a mixed 3.3-V/5-V system environment.

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.

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.

**GQN OR ZQN PACKAGE
(TOP VIEW)**



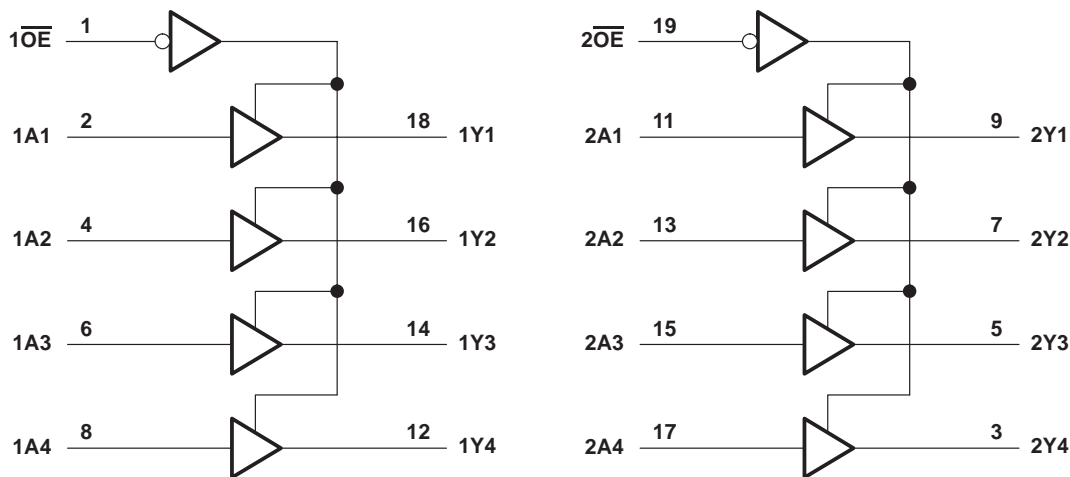
terminal assignments

	1	2	3	4
A	1A1	$\overline{1OE}$	V_{CC}	$\overline{2OE}$
B	1A2	2A4	2Y4	1Y1
C	1A3	2Y3	2A3	1Y2
D	1A4	2A2	2Y2	1Y3
E	GND	2Y1	2A1	1Y4

**FUNCTION TABLE
(each buffer)**

INPUTS		OUTPUT
\overline{OE}	A	Y
L	H	H
L	L	L
H	X	Z

logic diagram (positive logic)



Pin numbers shown are for the DB, DGV, DW, N, NS, PW, and RGY packages.

SN74LVC244A
OCTAL BUFFER/DRIVER
WITH 3-STATE OUTPUTS

SCAS414U – NOVEMBER 1992 – REVISED AUGUST 2003

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): DB package	70°C/W
(see Note 3): DGV package	92°C/W
(see Note 3): DW package	58°C/W
(see Note 3): GQN/ZQN package	78°C/W
(see Note 3): N package	69°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 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.
4. The package thermal impedance is calculated in accordance with JESD 51-5.



SN74LVC244A
OCTAL BUFFER/DRIVER
WITH 3-STATE OUTPUTS

SCAS414U – NOVEMBER 1992 – REVISED AUGUST 2003

recommended operating conditions (see Note 5)

		MIN	MAX	UNIT	
V _{CC}	Supply voltage	Operating	1.65	3.6	V
		Data retention only	1.5		
V _{IH}	High-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}		V
		V _{CC} = 2.3 V to 2.7 V	1.7		
		V _{CC} = 2.7 V to 3.6 V	2		
V _{IL}	Low-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.35 × V _{CC}		V
		V _{CC} = 2.3 V to 2.7 V	0.7		
		V _{CC} = 2.7 V to 3.6 V	0.8		
V _I	Input voltage	0	5.5	V	
V _O	Output voltage	High or low state	0	V _{CC}	V
		3-state	0	5.5	
I _{OH}	High-level output current	V _{CC} = 1.65 V	-4		mA
		V _{CC} = 2.3 V	-8		
		V _{CC} = 2.7 V	-12		
		V _{CC} = 3 V	-24		
I _{OL}	Low-level output current	V _{CC} = 1.65 V	4		mA
		V _{CC} = 2.3 V	8		
		V _{CC} = 2.7 V	12		
		V _{CC} = 3 V	24		
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.



SN74LVC244A OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

SCAS414U – NOVEMBER 1992 – REVISED AUGUST 2003

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

PARAMETER	TEST CONDITIONS	V _{CC}	MIN	TYP†	MAX	UNIT
V _{OH}	I _{OH} = -100 μA	1.65 V to 3.6 V	V _{CC} -0.2			V
	I _{OH} = -4 mA	1.65 V	1.2			
	I _{OH} = -8 mA	2.3 V	1.7			
	I _{OH} = -12 mA	2.7 V	2.2			
	I _{OH} = -24 mA	3 V	2.4			
V _{OL}	I _{OL} = 100 μA	1.65 V to 3.6 V			0.2	V
	I _{OL} = 4 mA	1.65 V			0.45	
	I _{OL} = 8 mA	2.3 V			0.7	
	I _{OL} = 12 mA	2.7 V			0.4	
	I _{OL} = 24 mA	3 V			0.55	
I _I	V _I = 0 to 5.5 V	3.6 V			±5	μA
I _{off}	V _I or V _O = 5.5 V	0			±10	μA
I _{OZ}	V _O = 0 to 5.5 V	3.6 V			±10	μA
I _{CC}	V _I = V _{CC} or GND	3.6 V	I _O = 0		10	μA
	3.6 V ≤ V _I ≤ 5.5 V‡				10	
ΔI _{CC}	One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND	2.7 V to 3.6 V			500	μA
C _i	V _I = V _{CC} or GND	3.3 V		4		pF
C _o	V _O = V _{CC} or GND	3.3 V		5.5		pF

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

‡ This applies in the disabled state only.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 1.5 V		V _{CC} = 1.8 V ± 0.15 V		V _{CC} = 2.5 V ± 0.2 V		V _{CC} = 2.7 V		V _{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _{pd}	A	Y	1	14.9	1	10.9	1	7.9	1	6.9	1.5	5.9	ns
t _{en}	\overline{OE}	Y	1	18.3	1	12.6	1	9.6	1	8.6	1.5	7.6	ns
t _{dis}	\overline{OE}	Y	1	16.1	1	12.1	1	7.8	1	6.8	1.5	6.5	ns

operating characteristics, T_A = 25°C

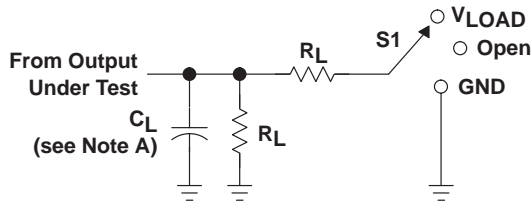
PARAMETER	TEST CONDITIONS	V _{CC} = 1.8 V	V _{CC} = 2.5 V	V _{CC} = 3.3 V	UNIT
		TYP	TYP	TYP	
C _{pd} Power dissipation capacitance per buffer/driver	Outputs enabled	43	43	44	pF
	Outputs disabled	1	1	2	



SN74LVC244A OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

SCAS414U – NOVEMBER 1992 – REVISED AUGUST 2003

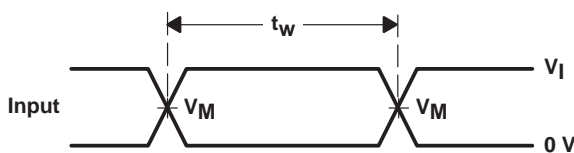
PARAMETER MEASUREMENT INFORMATION



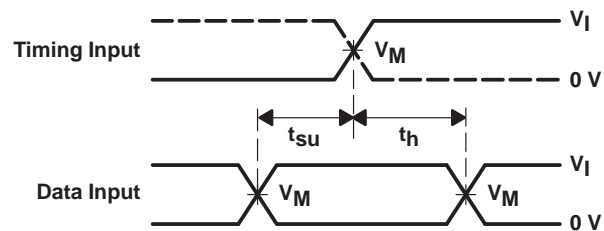
LOAD CIRCUIT

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

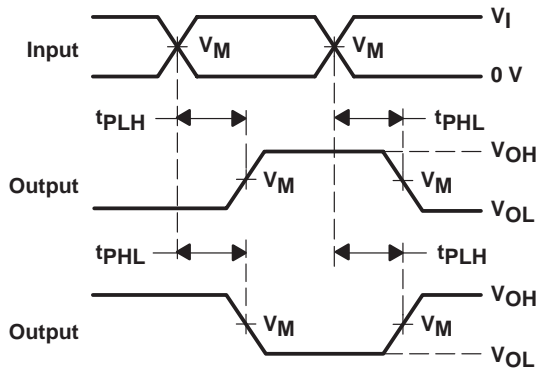
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_{Δ}
	V_I	t_r/t_f					
1.5 V	V_{CC}	≤ 2 ns	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	2 k Ω	0.1 V
$1.8 \text{ V} \pm 0.15 \text{ V}$	V_{CC}	≤ 2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k Ω	0.15 V
$2.5 \text{ V} \pm 0.2 \text{ V}$	V_{CC}	≤ 2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	≤ 2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
$3.3 \text{ V} \pm 0.3 \text{ V}$	2.7 V	≤ 2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V



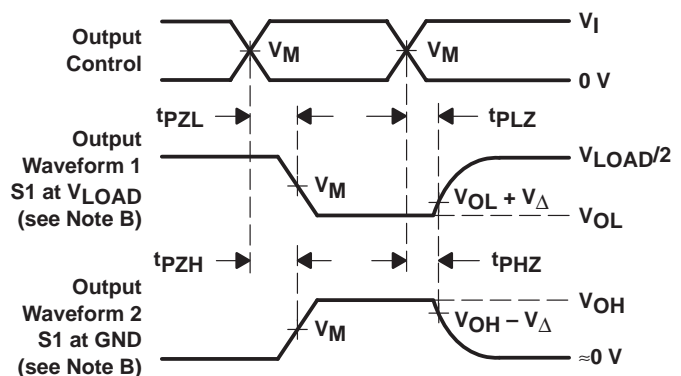
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



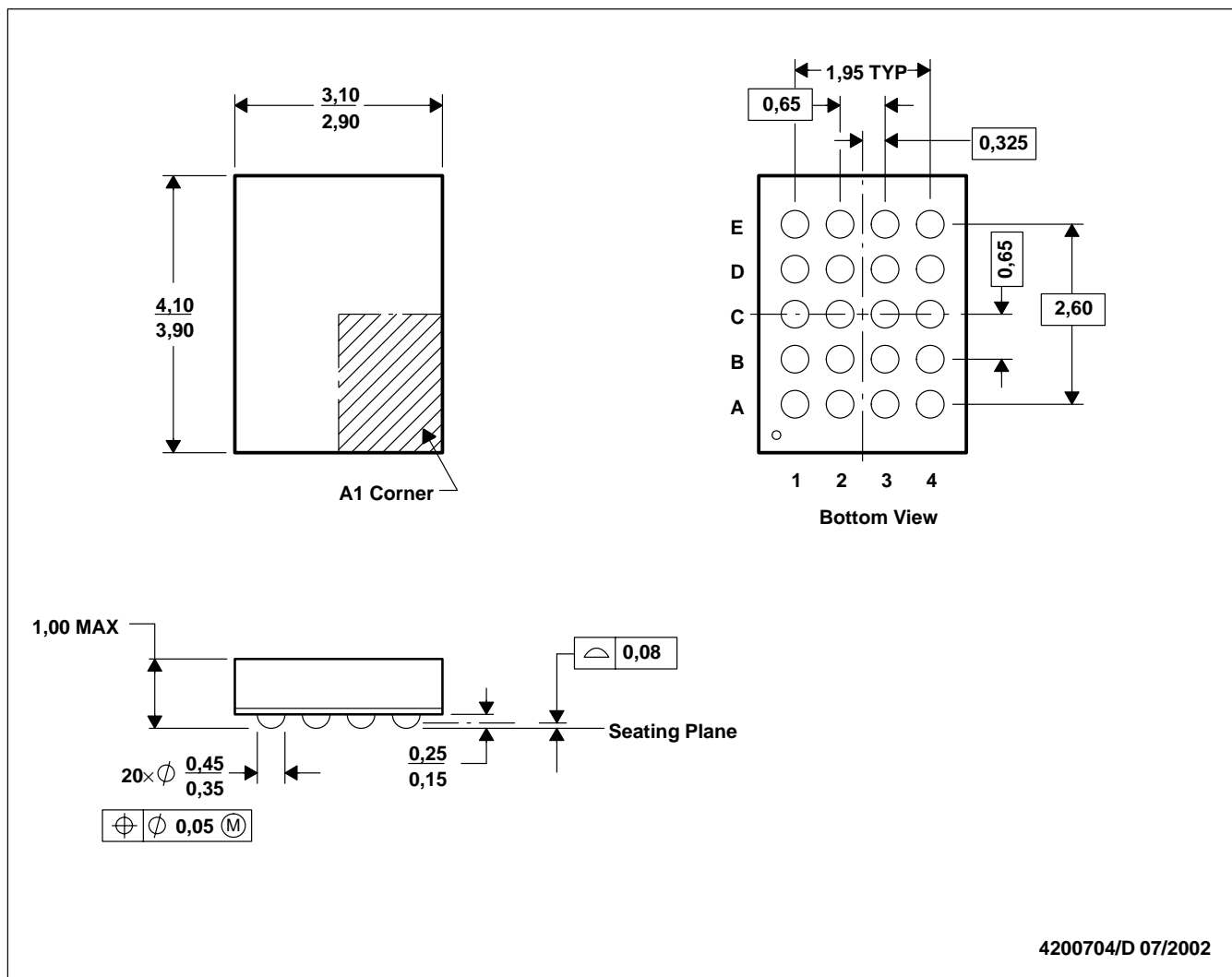
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- 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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$.
 - The outputs are measured one at a time with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .
 - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

GQN (R-PBGA-N20)

PLASTIC BALL GRID ARRAY



4200704/D 07/2002

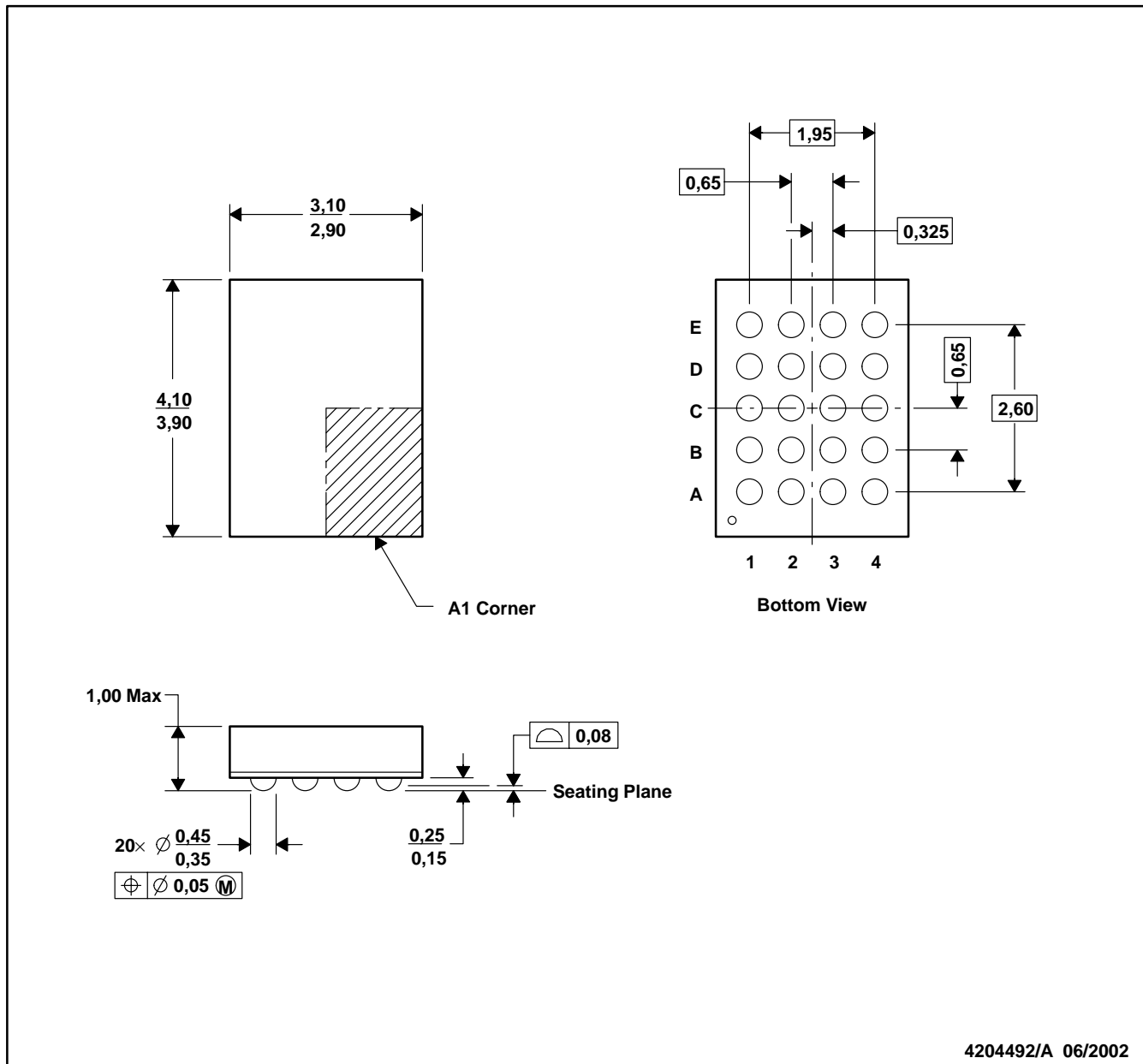
- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. MicroStar Junior™ configuration
 - D. Falls within JEDEC MO-225 variation BC.
 - E. This package is tin-lead (SnPb). Refer to the 20 ZQN package (drawing 4204492) for lead-free.

MicroStar Junior is a trademark of Texas Instruments.



ZQN (R-PBGA-N20)

PLASTIC BALL GRID ARRAY



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. MicroStar Junior™ configuration.
 D. Fall within JEDEC MO-225 variation BC.
 E. This package is lead-free. Refer to the 20 GQN package (drawing 4200704) for tin-lead (SnPb).

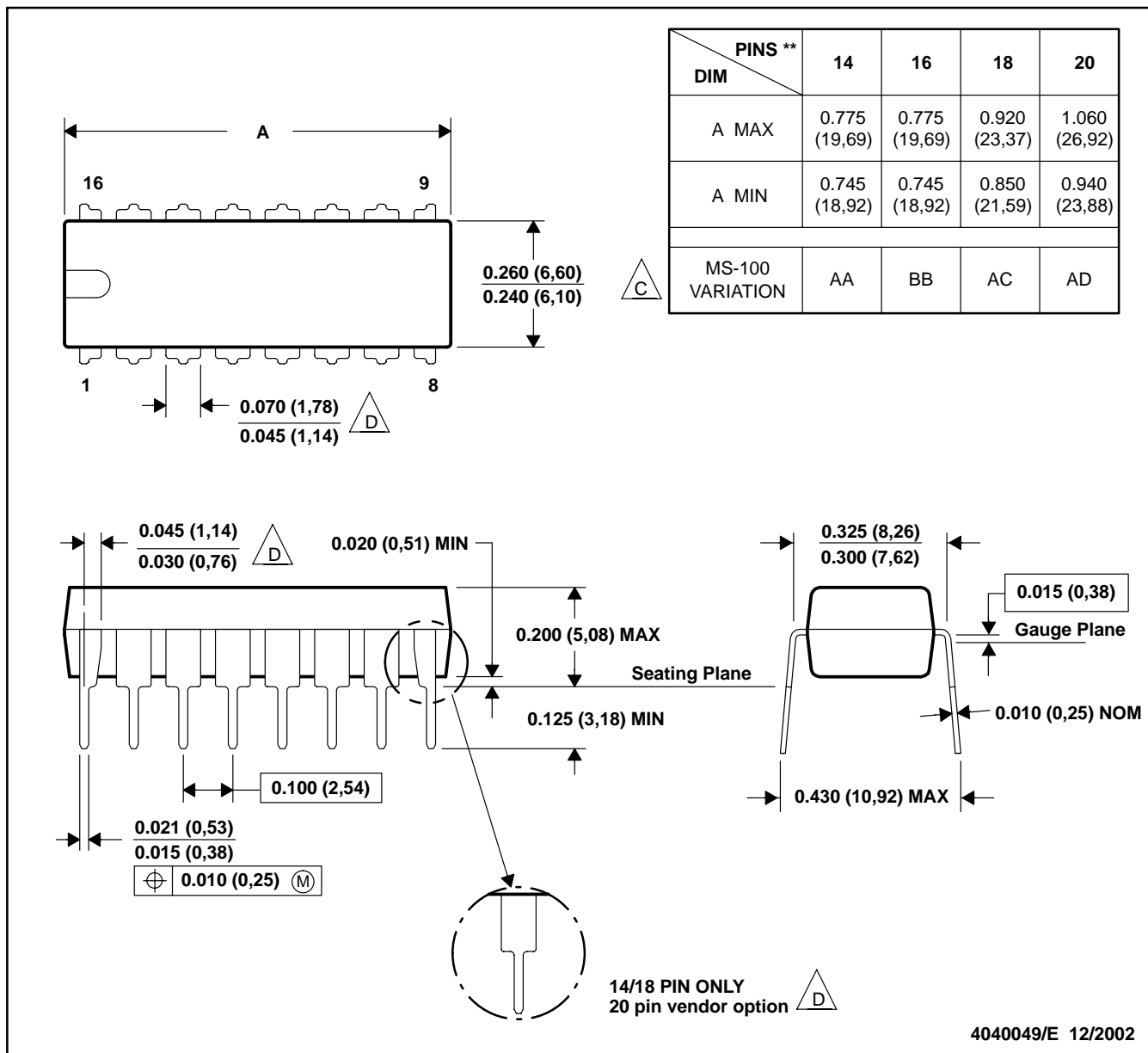
MicroStar Junior is a trademark of Texas Instruments.



N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 (C) Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 (D) The 20 pin end lead shoulder width is a vendor option, either half or full width.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN

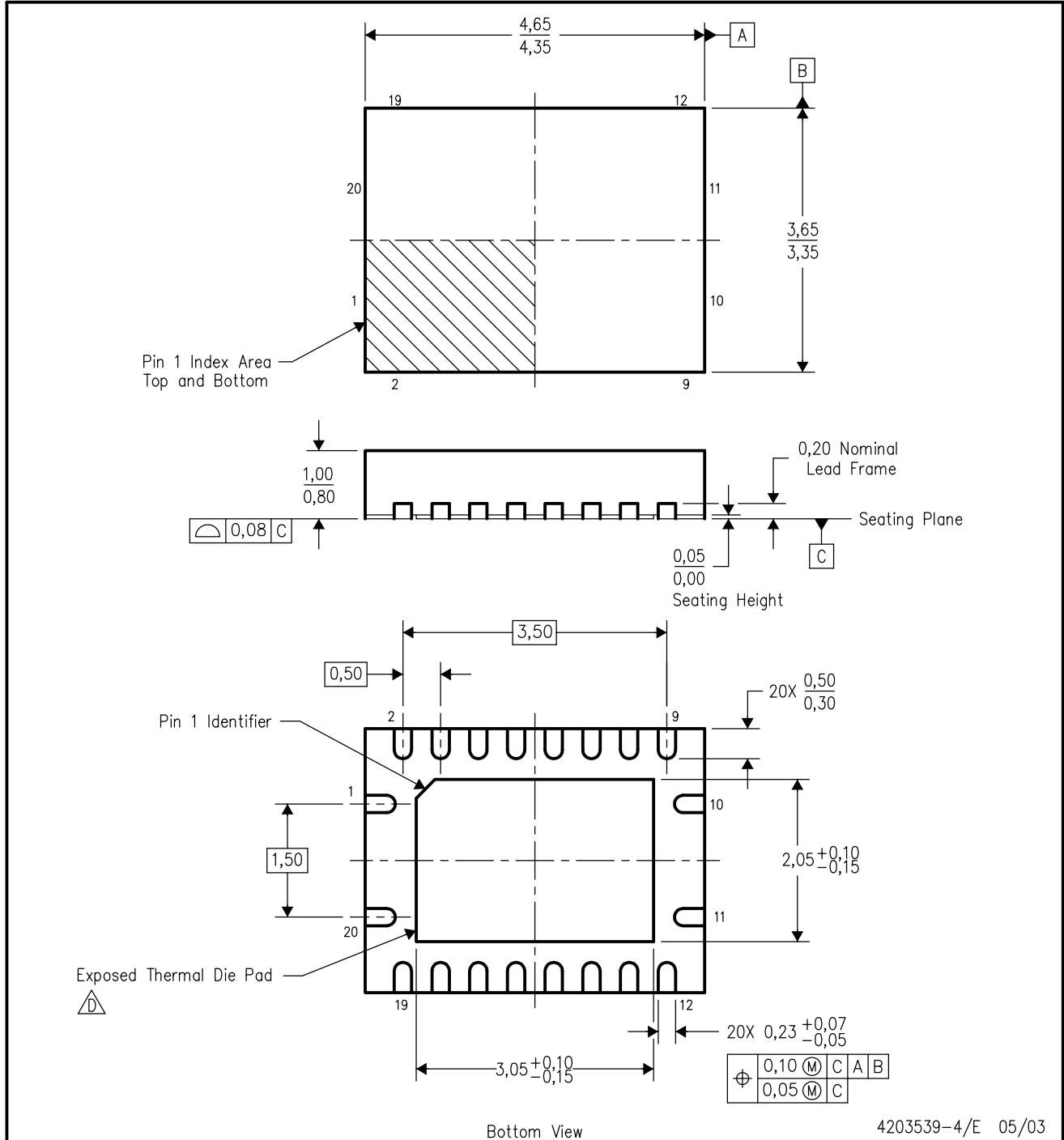


4073251/E 08/00

- 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

RGY (R-PQFP-N20)

PLASTIC QUAD FLATPACK

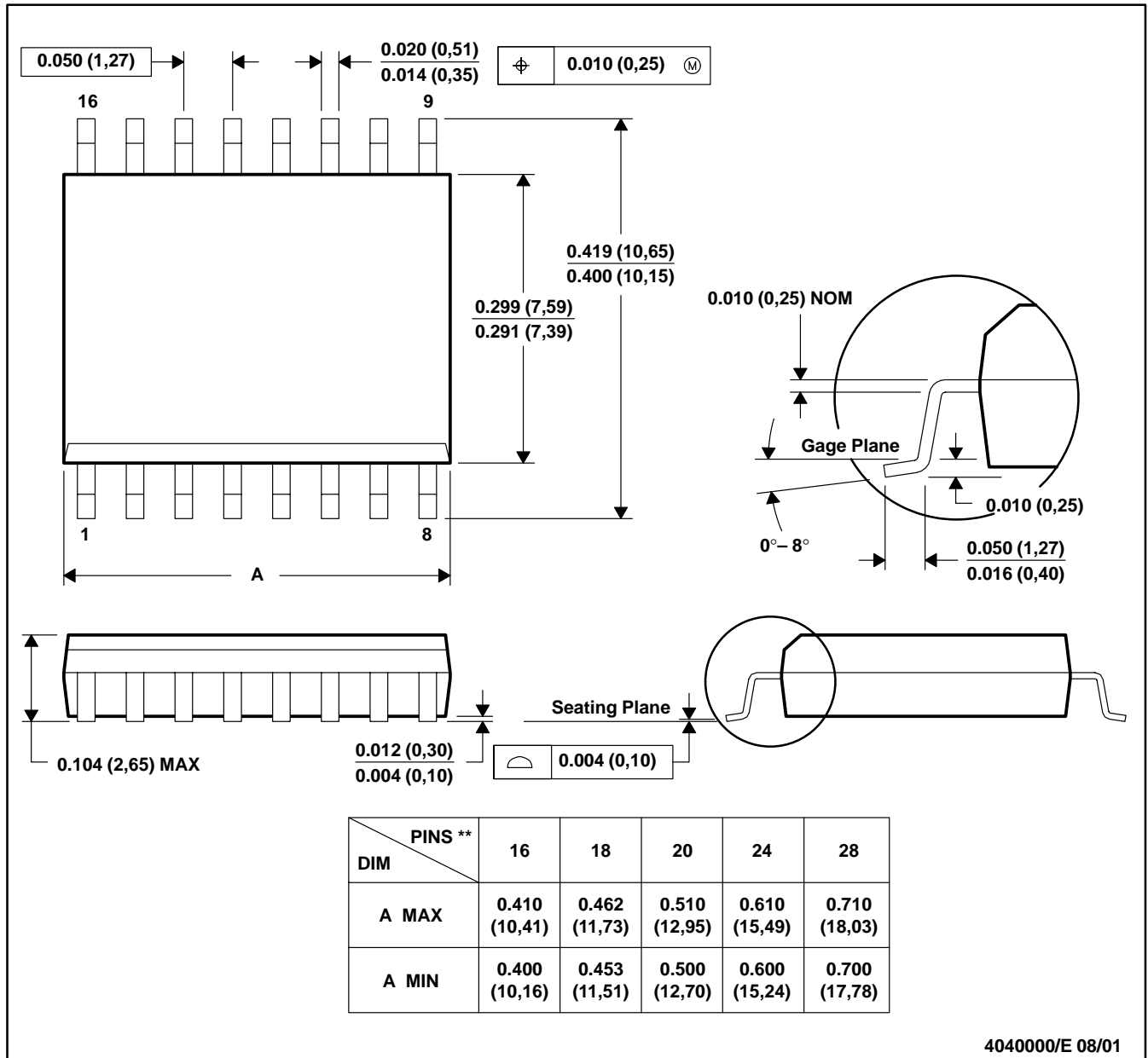


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 - The package thermal performance may be enhanced by bonding the thermal die pad to an external thermal plane. This pad is electrically and thermally connected to the backside of the die and possibly selected ground leads.
 - E. Package complies to JEDEC MO-241 variation BC.

DW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

16 PINS SHOWN



4040000/E 08/01

- 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

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



4040064/F 01/97

- 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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

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

Copyright © 2003, Texas Instruments Incorporated