

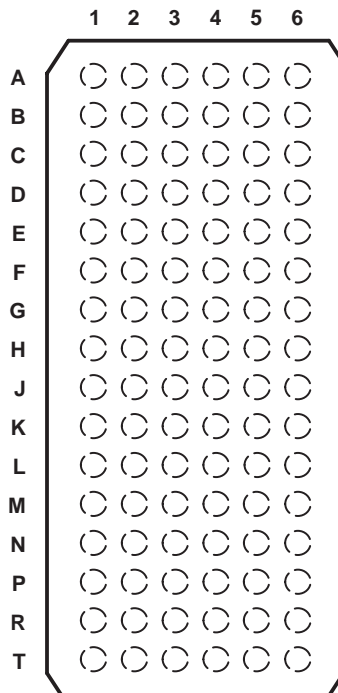
SN74LVTH32245

3.3-V ABT 32-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCBS750A – OCTOBER 2000 – REVISED SEPTEMBER 2003

- Member of the Texas Instruments Widebus+™ Family
- State-of-the-Art Advanced BiCMOS Technology (ABT) Design for 3.3-V Operation and Low Static-Power Dissipation
- Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- I_{off} and Power-Up 3-State Support Hot Insertion
- Supports Unregulated Battery Operation Down to 2.7 V
- Supports Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V V_{CC})
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- 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)

GKE OR ZKE PACKAGE
(TOP VIEW)



terminal assignments

	1	2	3	4	5	6
A	1B2	1B1	1DIR	1 \overline{OE}	1A1	1A2
B	1B4	1B3	GND	GND	1A3	1A4
C	1B6	1B5	1 V_{CC}	1 V_{CC}	1A5	1A6
D	1B8	1B7	GND	GND	1A7	1A8
E	2B2	2B1	GND	GND	2A1	2A2
F	2B4	2B3	1 V_{CC}	1 V_{CC}	2A3	2A4
G	2B6	2B5	GND	GND	2A5	2A6
H	2B7	2B8	2DIR	2 \overline{OE}	2A8	2A7
J	3B2	3B1	3DIR	3 \overline{OE}	3A1	3A2
K	3B4	3B3	GND	GND	3A3	3A4
L	3B6	3B5	2 V_{CC}	2 V_{CC}	3A5	3A6
M	3B8	3B7	GND	GND	3A7	3A8
N	4B2	4B1	GND	GND	4A1	4A2
P	4B4	4B3	2 V_{CC}	2 V_{CC}	4A3	4A4
R	4B6	4B5	GND	GND	4A5	4A6
T	4B7	4B8	4DIR	4 \overline{OE}	4A8	4A7

description/ordering information

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	LFBGA – GKE	Tape and reel	SN74LVTH32245GKER	HV245
	LFBGA – ZKE (Pb-free)		SN74LVTH32245ZKER	

† 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.

Widebus+ is a trademark 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.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2003, Texas Instruments Incorporated

SN74LVTH32245

3.3-V ABT 32-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCBS750A – OCTOBER 2000 – REVISED SEPTEMBER 2003

description/ordering information (continued)

The SN74LVTH32245 is a 32-bit noninverting 3-state transceiver designed for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment.

This device can be used as four 8-bit transceivers, two 16-bit transceivers, or one 32-bit transceiver. The device allows data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable (\overline{OE}) input can be used to disable the devices so that the buses are effectively isolated.

When V_{CC} is between 0 and 1.5 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V, \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.

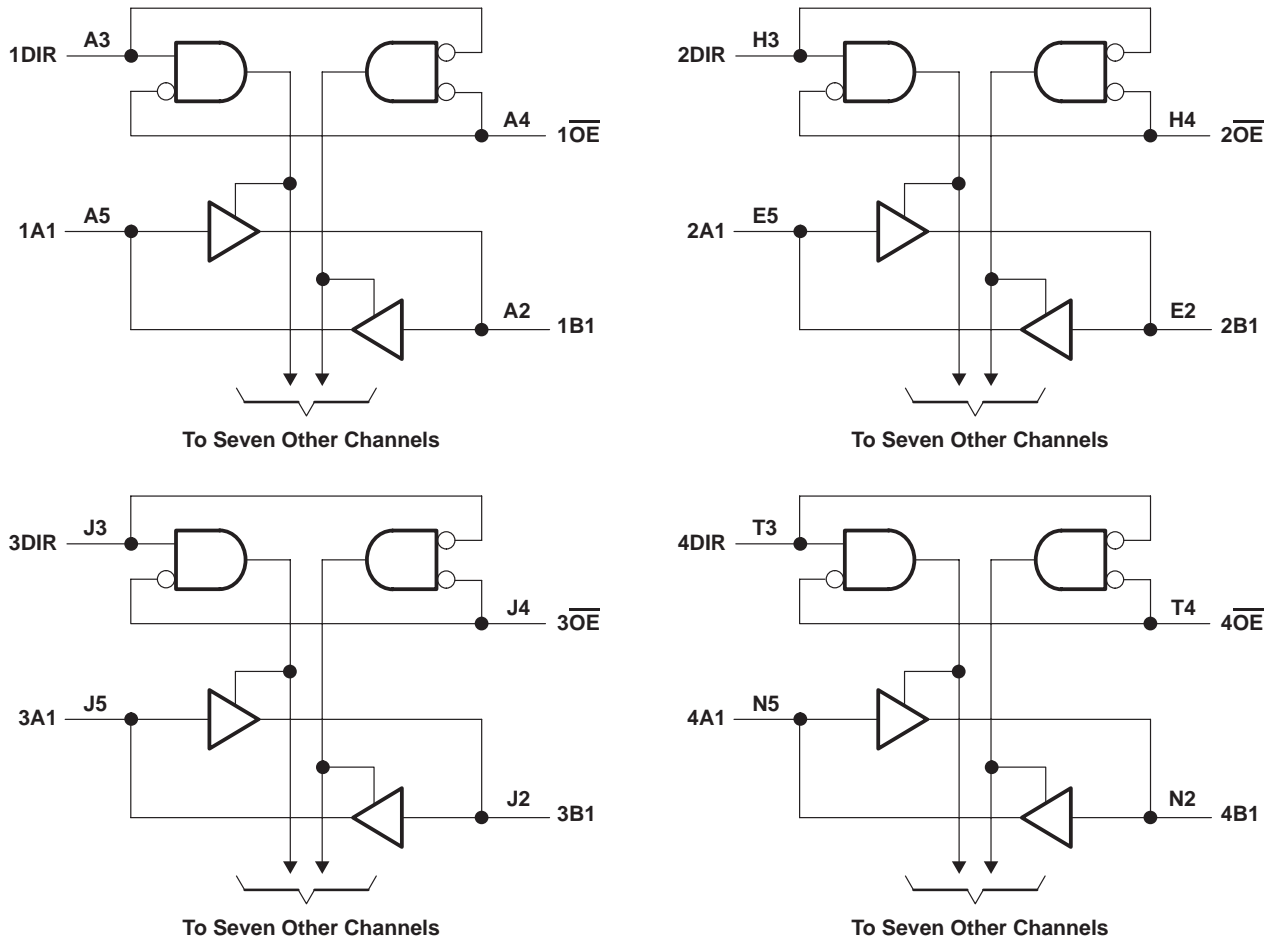
This device is fully specified for hot-insertion applications using I_{off} and power-up 3-state. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

FUNCTION TABLE
(each 8-bit transceiver)

INPUTS		OPERATION
\overline{OE}	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

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 4.6 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
Voltage range applied to any output in the high state, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Current into any output in the low state, I_O	128 mA
Current into any output in the high state, I_O (see Note 2)	64 mA
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Package thermal impedance, θ_{JA} (see Note 3): GKE/ZKE package	40°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 clamp-current ratings are observed.
 2. This current flows only when the output is in the high state and $V_O > V_{CC}$.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

SN74LVTH32245
3.3-V ABT 32-BIT BUS TRANSCEIVER
WITH 3-STATE OUTPUTS

SCBS750A – OCTOBER 2000 – REVISED SEPTEMBER 2003

recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V_{CC}	Supply voltage		2.7	3.6	V
V_{IH}	High-level input voltage		2		V
V_{IL}	Low-level input voltage			0.8	V
V_I	Input voltage			5.5	V
I_{OH}	High-level output current			–32	mA
I_{OL}	Low-level output current			64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		200		μ s/V
T_A	Operating free-air temperature		–40	85	°C

NOTE 4: All unused control 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.

SN74LVTH32245
3.3-V ABT 32-BIT BUS TRANSCEIVER
WITH 3-STATE OUTPUTS

SCBS750A – OCTOBER 2000 – REVISED SEPTEMBER 2003

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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V _{IK}		V _{CC} = 2.7 V, I _I = −18 mA				−1.2	V
V _{OH}		V _{CC} = 2.7 V to 3.6 V, I _{OH} = −100 μA		V _{CC} −0.2			V
		V _{CC} = 2.7 V, I _{OH} = −8 mA		2.4			
		V _{CC} = 3 V, I _{OH} = −32 mA		2			
V _{OL}		V _{CC} = 2.7 V		I _{OL} = 100 μA		0.2	V
				I _{OL} = 24 mA		0.5	
		V _{CC} = 3 V		I _{OL} = 16 mA		0.4	
				I _{OL} = 32 mA		0.5	
				I _{OL} = 64 mA		0.55	
I _I	Control inputs	V _{CC} = 3.6 V, V _I = V _{CC} or GND		±1		μA	
		V _{CC} = 0 or 3.6 V, V _I = 5.5 V		10			
	A or B ports‡	V _{CC} = 3.6 V		V _I = 5.5 V			20
				V _I = V _{CC}			1
				V _I = 0			−5
I _{off}		V _{CC} = 0, V _I or V _O = 0 to 4.5 V		±100		μA	
I _{I(hold)}	A or B ports	V _{CC} = 3 V		V _I = 0.8 V		75	μA
				V _I = 2 V		−75	
		V _{CC} = 3.6 V,§		V _I = 0 to 3.6 V		±500	
I _{OZPU}		V _{CC} = 0 to 1.5 V, V _O = 0.5 V to 3 V, \overline{OE} = don't care		±100		μA	
I _{OZPD}		V _{CC} = 1.5 V to 0, V _O = 0.5 V to 3 V, \overline{OE} = don't care		±100		μA	
I _{CC}		V _{CC} = 3.6 V, I _O = 0, V _I = V _{CC} or GND		Outputs high		0.38	mA
				Outputs low		10	
				Outputs disabled		0.38	
ΔI _{CC} ¶		V _{CC} = 3 V to 3.6 V, One input at V _{CC} − 0.6 V, Other inputs at V _{CC} or GND		0.2		mA	
C _i		V _I = 3 V or 0		4		pF	
C _{io}		V _O = 3 V or 0		10		pF	

† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

‡ Unused pins at $V_{CC}\text{ or GND}$

§ This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

¶ This is the increase in supply current for each input that is at the specified TTL voltage level, rather than $V_{CC}\text{ or GND}$.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	VCC = 3.3 V ± 0.3 V			VCC = 2.7 V		UNIT
			MIN	TYP†	MAX	MIN	MAX	
tPLH	A or B	B or A	1.5	2.3	3.3	3.7		ns
tPHL			1.3	2.1	3.3	3.5		
tPZH	OE	A or B	1.5	2.8	4.5	5.3		ns
tPZL			1.6	2.9	4.6	5.2		
tPHZ	OE	A or B	2.3	3.7	5.1	5.5		ns
tPLZ			2.2	3.5	5.1	5.4		
t _{sk(o)}			0.5					ns

† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.



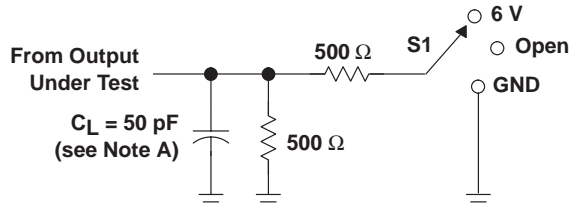
SN74LVTH32245

3.3-V ABT 32-BIT BUS TRANSCEIVER

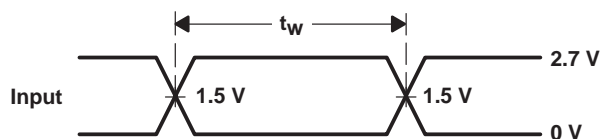
WITH 3-STATE OUTPUTS

SCBS750A – OCTOBER 2000 – REVISED SEPTEMBER 2003

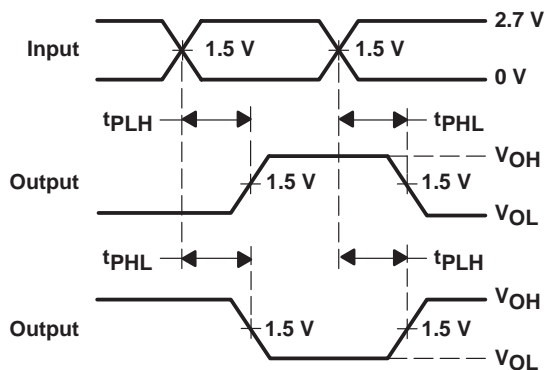
PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

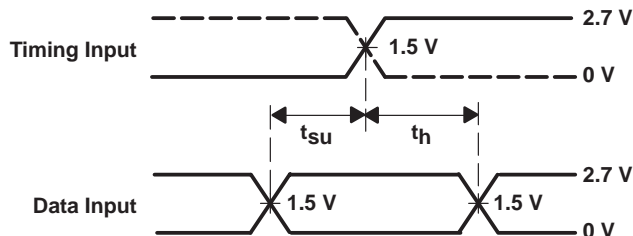


VOLTAGE WAVEFORMS
PULSE DURATION

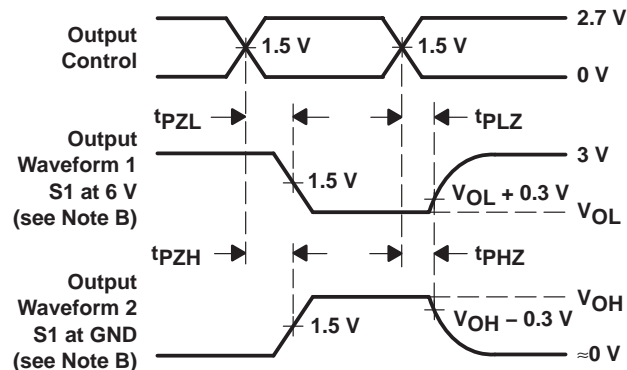


VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 D. The outputs are measured one at a time with one transition per measurement.

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⁾
SN74LVTH32245GKER	ACTIVE	LFBGA	GKE	96	1000	TBD	SNPB	Level-3-220C-168 HR
SN74LVTH32245ZKER	ACTIVE	LFBGA	ZKE	96	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-250C-168 HR

⁽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.

OBSELETE: 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)

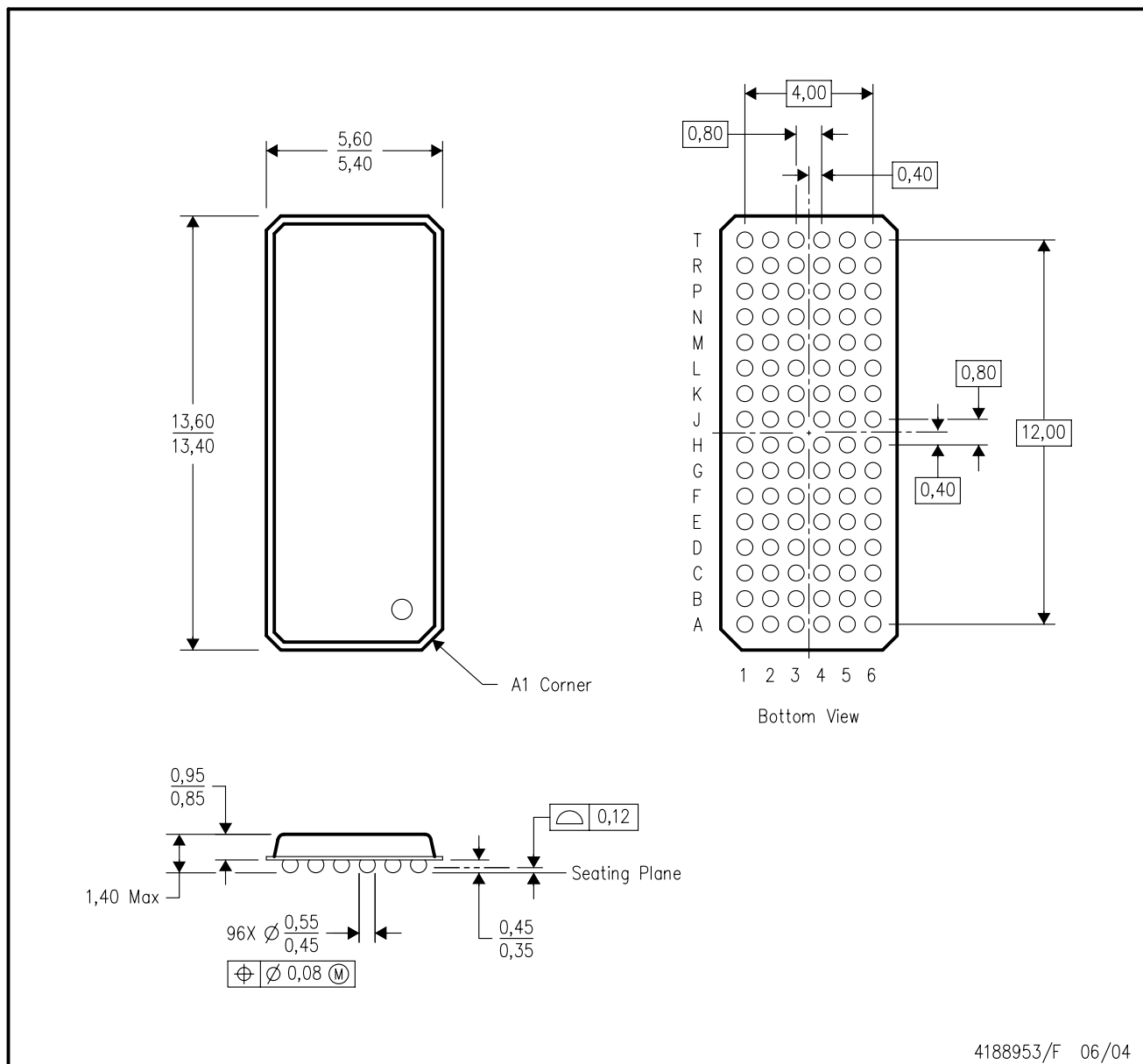
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

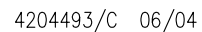
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

GKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-205 variation CC.
 - D. This package is tin-lead (SnPb). Refer to the 96 ZKE package (drawing 4204493) for lead-free.



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Falls within JEDEC MO-205 variation CC.
D. This package is lead-free. Refer to the 96 GKE package (drawing 4188953) for tin-lead (SnPb).

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 © 2005, Texas Instruments Incorporated