

LB1031AB/AC GENERAL PURPOSE WIDEBAND OP-AMPS

DESCRIPTION

The LB1031AB/AC functions as a voice-frequency operational amplifier and is intended for general-purpose use where internal compensation is desired. This device features good output current capability, short circuit protection, static discharge protection, and large common-mode voltage range. The differential voltage range is limited to ± 6.0 volts. This device will operate over the power-supply range of ± 5.0 to ± 15 volts. The LB1031AC features an offset null adjustment.

FEATURES

- GUARANTEED MINIMUM UNITY-GAIN FREQUENCY OF 4.0 MHz
- 5.0 V/ μ SEC TYPICAL SLEW RATE
- LARGE COMMON-MODE VOLTAGE RANGE
- 12 mA MINIMUM OUTPUT CURRENT CAPABILITY
- OFFSET VOLTAGE NULL CAPABILITY (LB1031AC)
- SHORT CIRCUIT CURRENT LIMITED
- INTERNAL "T" COMPENSATION (LB1031AB)
- OPTIONAL INTERNAL "T" OR FEEDBACK COMPENSATION (LB1031AC)
- STATIC DISCHARGE PROTECTION
- 8- OR 16-LEAD DIP; 400 mW
- SUPPLY RANGE VOLTAGE: ± 5.0 to ± 15 VOLTS
- DIFFERENTIAL-MODE VOLTAGE RANGE: ± 6.0 VOLTS

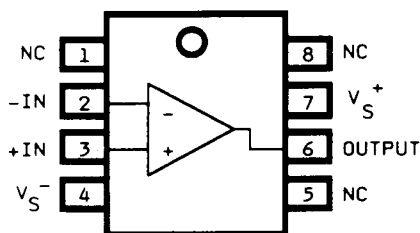


Fig. 1—LB1031AB Pinout Diagram and Functional Block Diagram

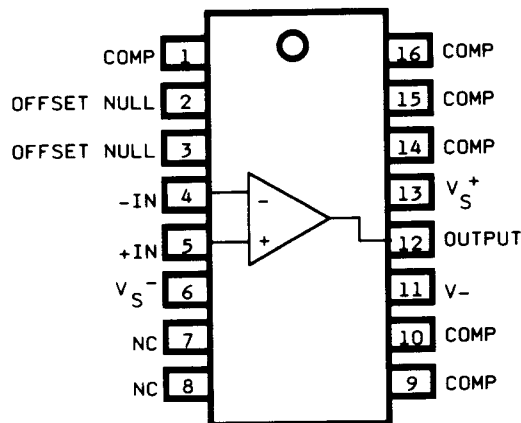


Fig. 2—LB1031AC Pinout Diagram and Functional Block Diagram

AT&T reserves the right to make changes to the product(s) or circuit(s) described herein without notice. No liability is assumed as a result of their use or application. No rights under any patent accompany the sale of any such product or circuit.

MAXIMUM RATINGS (At 25°C)	
Power-Supply Voltage Between V_{S+} and V_{S-}	30 V
Input Voltage Between +IN and -IN	± 6.0 V
Power Dissipation	400 mW
Storage Temperature	-40 to +125°C
Operating Temperature	0 to 60°C

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise specified)

Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information purposes only and are not part of the testing requirements.

CHARACTERISTIC AND TEST CONDITION	SYMBOL	MIN.	TYP ^①	MAX.	UNIT
Test Condition Supply Voltage	V_S	± 15	± 15	± 15	V
Extrapolated Unity Gain Frequency ^② ($f = 1.0$ kHz, $C_C = C_{INT}$)	f_t	4.0	5.6	9.0	MHz
Open-Loop Voltage Gain ($f = 100$ Hz, $C_C = 0$)	A_{VOL}	72	—	79	dB
Input Offset Voltage (Figure 3)	$ V_{IO} $	—	0.5	4.5	mV
Input Bias Current (Figure 3)	I_{IB}	—	800	3500	nA
Input Offset Current (Figure 3)	$ I_{IO} $	—	40	700	
Output Voltage Swing ($R_L = 10$ k Ω) (Figure 4)	V_{OM}	+13.0 -13.8	+13.5 -14.2	—	V(peak)
Output Current Drive ($R_L = 200$ Ω) ^②	I_o	+12 -12	+31 -27	+40 -40	mA
Common-Mode Voltage Range ($\Delta = 2.0$ mV)	CMVR	+12.5 -14.0	+14.1 -14.5	—	V
Common-Mode Rejection Ratio	CMRR	86	105	—	dB
Power-Supply Rejection Ratio (± 5 to ± 15 V) (Figure 5)	$ PSRR(\pm) $	—	3.0	50	$\mu\text{V/V}$
Power-Supply Current (Figure 6)	I_{PS}	0.8	1.1	1.7	mA
Differential Input Breakdown Voltage	$V_{(BR)II}$	± 6.0	± 8.5	—	V
Slew Rate ($C_C = C_{INT}$) ^②	SR	—	5.0	—	V/ μs

^①Individual devices may differ significantly from the typical values shown.

^②This condition is not tested in production devices.

SIMPLIFIED TEST CIRCUITS

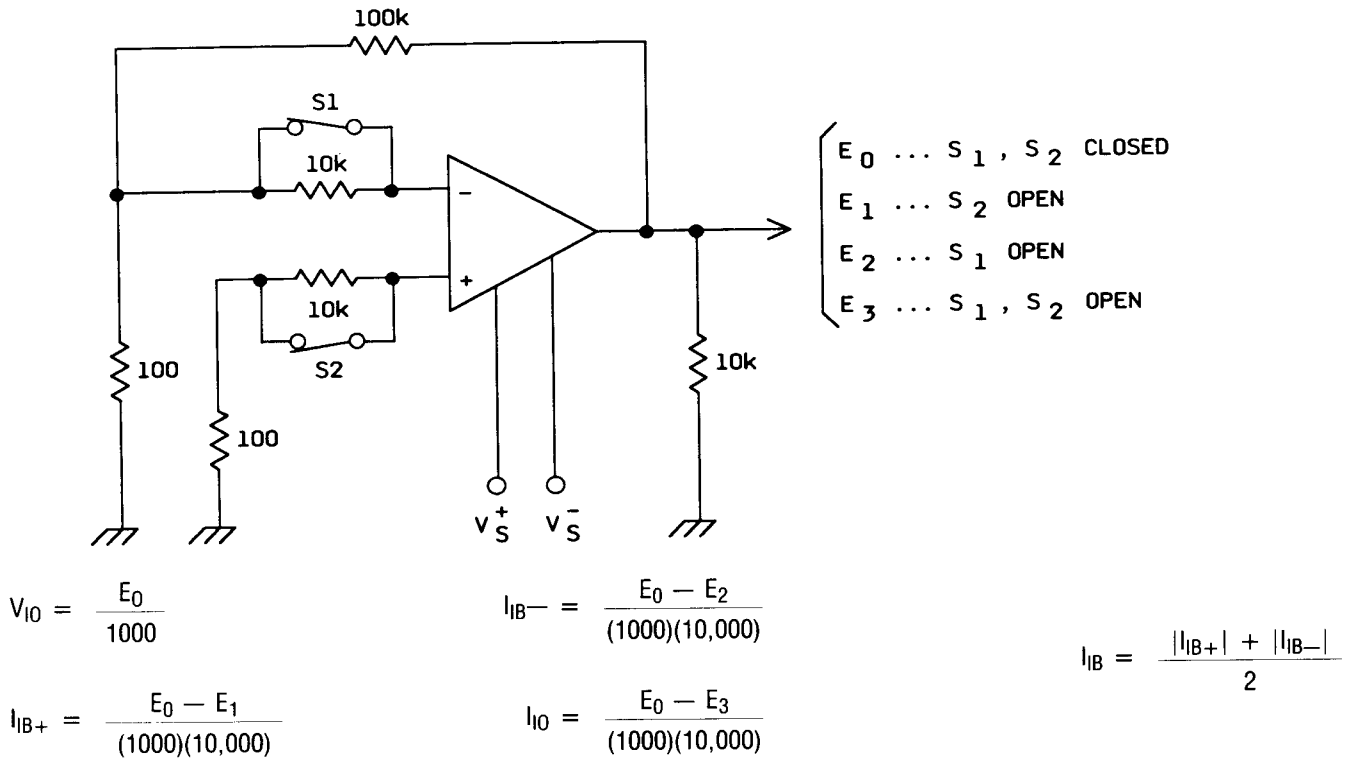


Fig. 3—Test Circuit, Input Offset Voltage (V_{IO}), Input Bias Current (I_{IB}), and Input Offset Current (I_{IO})^③

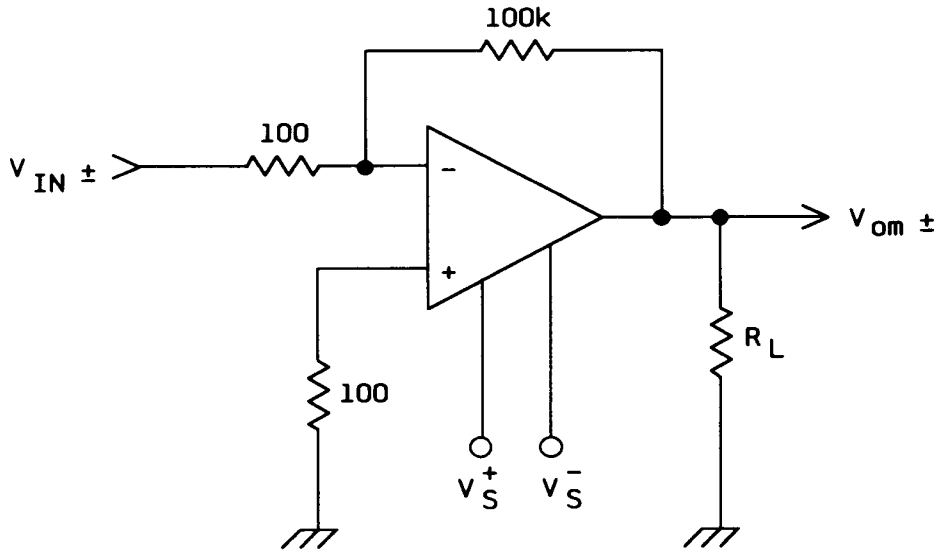


Fig. 4—Test Circuit, Output Voltage Swing^③

③ The following applies except where noted:

For the LB1031AB

- a. Connect to ground NC leads 1, 5, and 8.

For the LB1031AC

- a. The two COMP pins 1 and 16 are connected together.
- b. The two COMP pins 10 and 9 are connected together.
- c. The two OFFSET NULL leads 2 and 3 are connected to V_S^+ , lead 13.
- d. A 10-megohm resistor is connected from COMP lead 15 to lead 14.

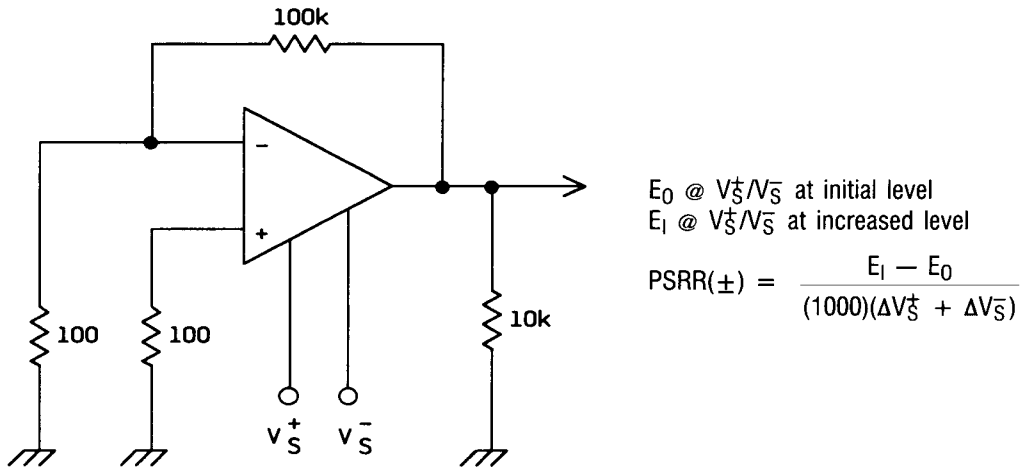


Fig. 5—Test Circuit, Power-Supply Rejection Ratio^③

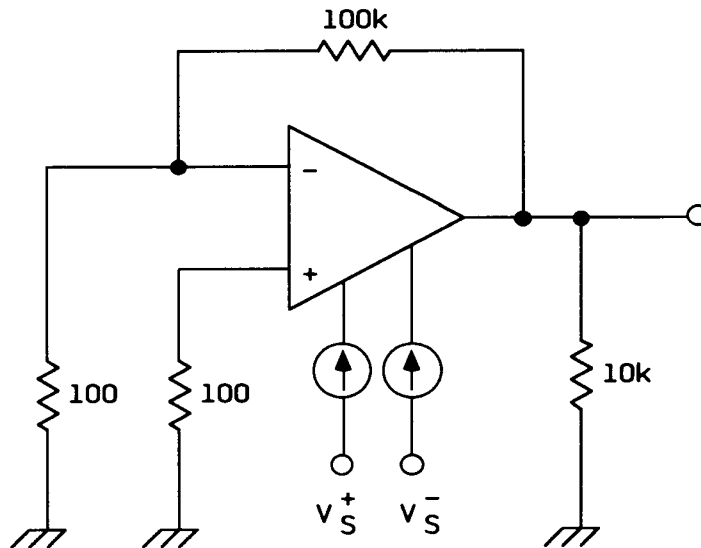


Fig. 6—Test Circuit, Power-Supply Current^③

LB1031AB CONNECTION OPTIONS

This amplifier is internally compensated and offers no compensation options. It is designed for use with internal "T" compensation and provides high gain over the voice frequency bandwidth.

A "T" compensated amplifier will exhibit considerable peaking for closed loop gains greater than 20 dB. Typical open-loop gain and phase relationships are shown in the Frequency Characteristics section.

Capacitive loading (C_L) coupled with the high-frequency output resistance (R_O) of the amplifier will add a pole to the open-loop response at $f = 1/2\pi R_O C_L$. For "T" compensated amplifiers, this added pole can cause oscillation for C_L greater than 200 pF. Isolating the capacitor from the output of the amplifier and the feedback loop with about 50 Ω will insure stability.

LB1031AC CONNECTION OPTIONS

The diagrams show various connection options. Combinations of the options are, of course, possible.

Figure 7 shows connections for the basic circuit operation with internal "T" compensation and no offset null. Offset null may be accomplished by placing a 200 Ω potentiometer between leads 2 and 3 with the wiper arm connected to the positive supply (Figure 9).

Three internal and one external compensation options are shown. This amplifier is designed for use with "T" compensation to provide high gain over the voice frequency bandwidth. A "T" compensated amplifier will exhibit considerable peaking for closed-loop gains greater than 20 dB.

Internal feedback compensation (Figure 8) provides 6 dB/octave roll-off with reduced bandwidth ($f_T \geq 2$ MHz) and increased phase margin. Increased bandwidth ($f_T \geq 4$ MHz) is obtained with an external resistor (Figure 9) or with external compensation (Figure 10).

Capacitive loading (C_L) coupled with the high-frequency output resistance (R_O) of the amplifier will add a pole to the open-loop response at $f = 1/2\pi R_O C_L$. For "T" compensated amplifiers, this added pole can cause oscillation for C_L greater than 200 pF. Isolating the capacitor from the output of the amplifier and the feedback loop with about 50 Ω will insure stability. The internal feedback compensation, with its improved phase margin and lower bandwidth, may also be used to insure stability with capacitive loading.

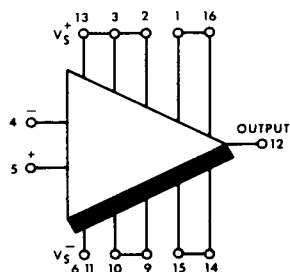


Fig. 7—1031AC No Offset Null Internal "T" Compensation

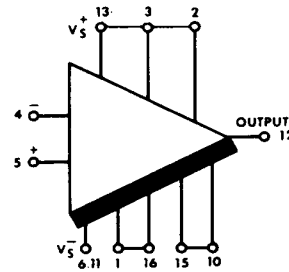


Fig. 8—1031AC No Offset Null Internal Feedback Compensation

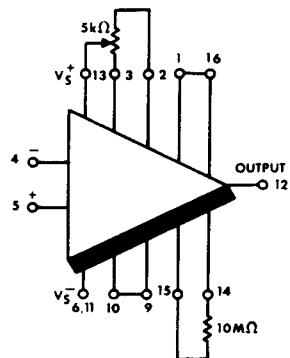


Fig. 9—1031AC Offset Null Feedback Compensation

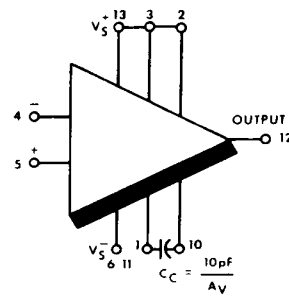


Fig. 10—1031AC No Offset Null External Compensation

FREQUENCY CHARACTERISTICS

With internal feedback compensation, the normal 6.0 dB/octave roll-off is obtained (Figure 11, Curve I). With this compensation, a unity gain amplifier will show no high-frequency peaking and the step response will exhibit no overshoot or ringing. However, open-loop gain at the upper edge of the voiceband (3.5 kHz) is only about 55 dB. For some applications, at least 70 dB open-loop gain 3.5 kHz is desired.

The internal "T" compensation can achieve high open-loop gain over the voice-frequency bandwidth. Double-pole, single-zero roll-off is obtained as shown. At unity gain, the phase margin (Figure 11, Curve II) is about 50 degrees, and a slight amount of high-frequency (5.0 MHz) peaking may occur. Closed-loop gains near 20 dB will experience peaking since the closed-loop gain intersects the open-loop response near or on the 12 dB/octave slope. For closed-loop gains above 20 dB, the peaking will exceed 3.0 dB. Furthermore, the double-pole, single-zero roll-off may introduce potentially undesirable features in the step response. However, "T" compensation does have the advantage of greater than 70 dB of open-loop gain over the voice-frequency bandwidth.

The power-supply rejection and common-mode rejection are expected to have frequency dependence similar to the open-loop gain. Thus, at 10 kHz, a "T" compensated amplifier will have better power-supply rejection and common-mode rejection than a feedback compensated amplifier. At dc or very-low frequency, there will be no significant difference.

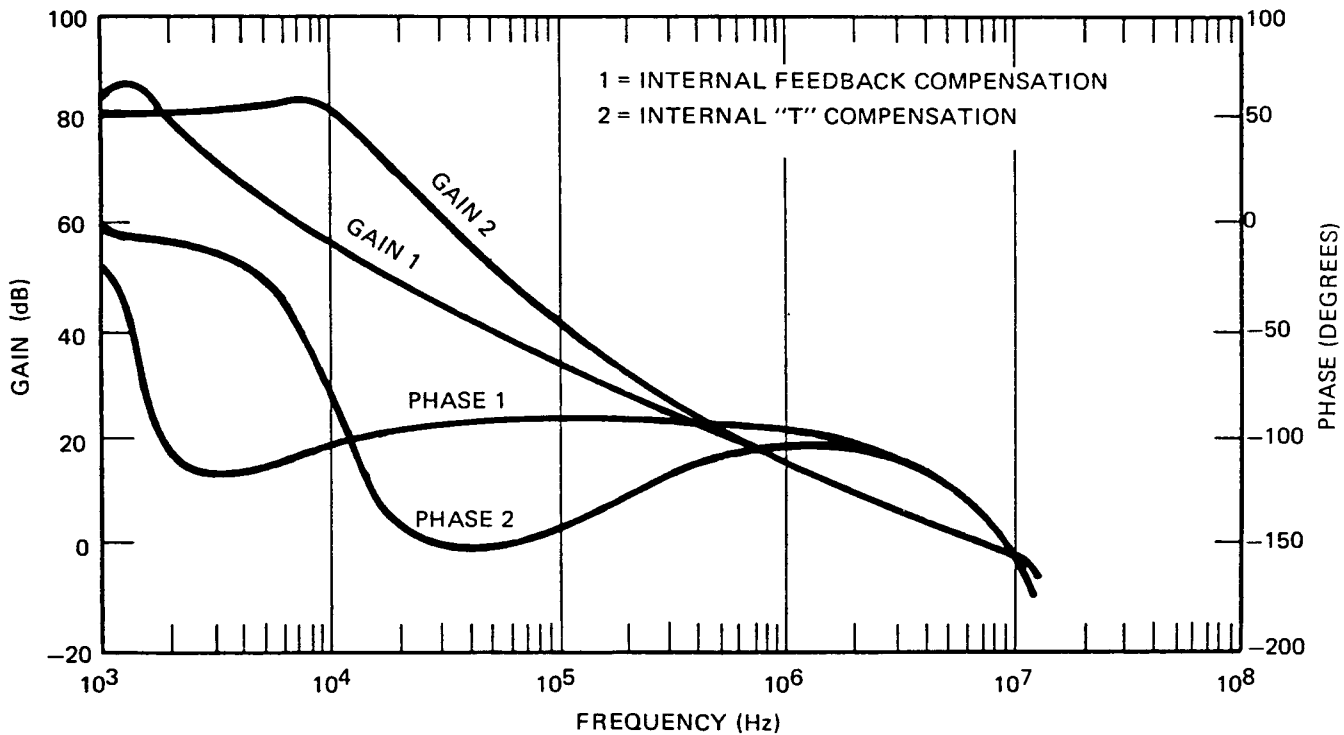
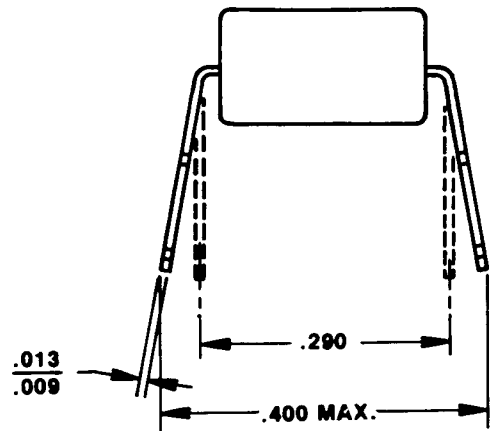
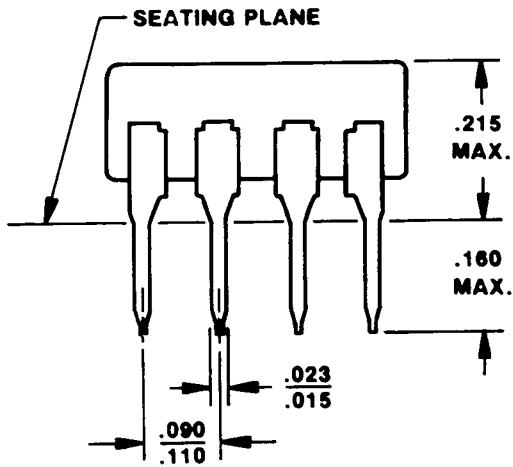
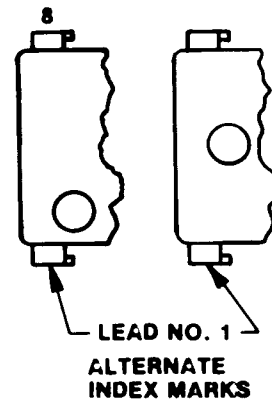
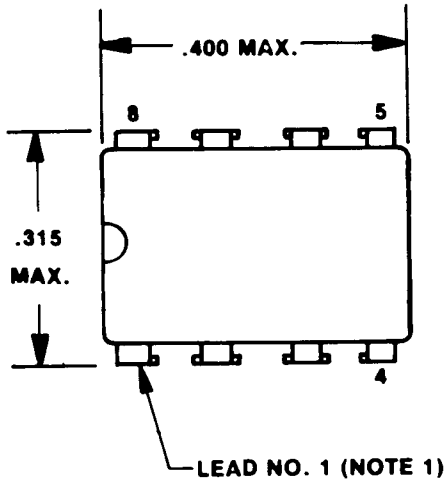


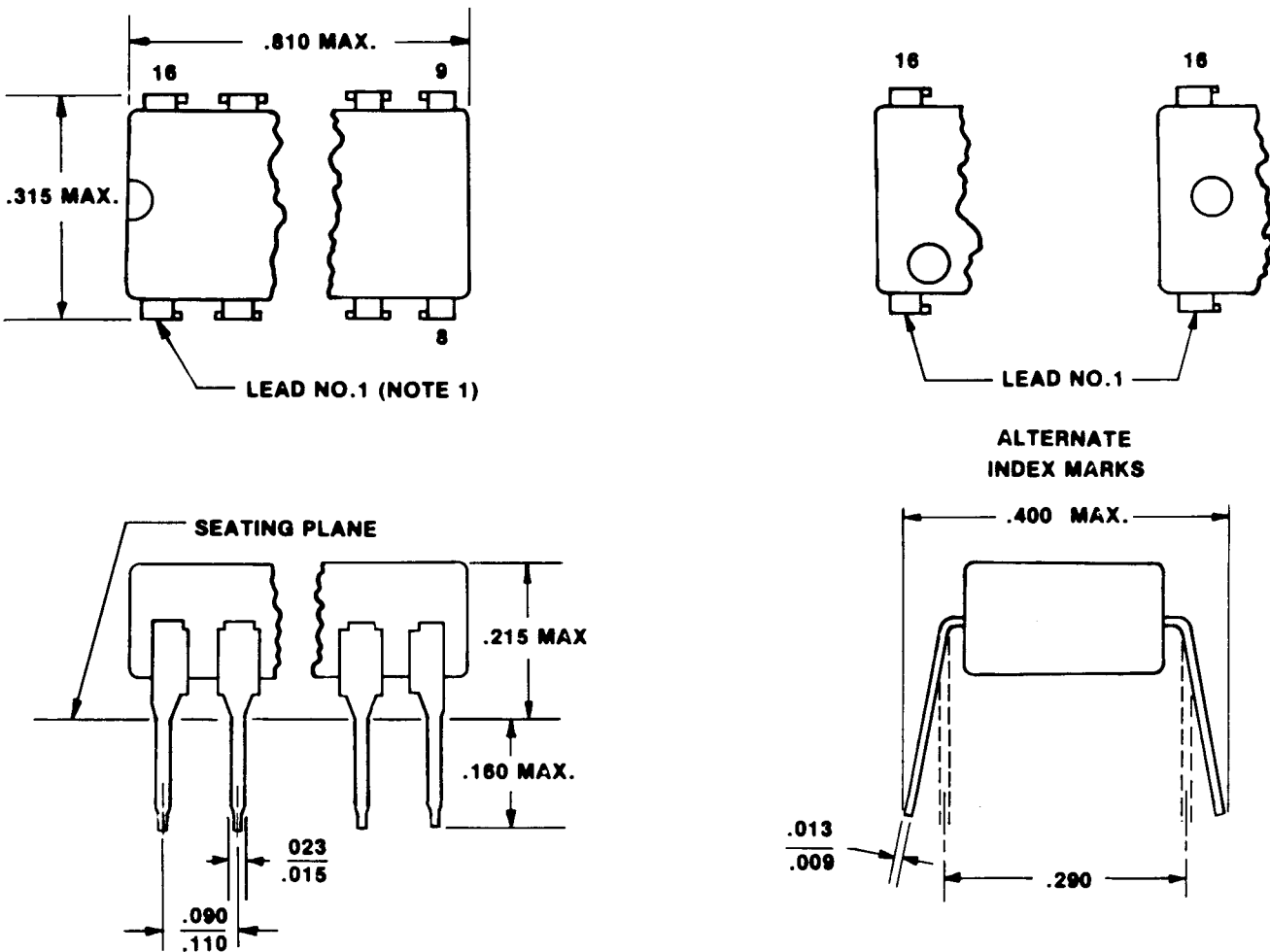
Fig. 11—Gain and Phase vs. Frequency

OUTLINE DRAWING LB1031AB (Dimensions in Inches)



LB1031AB/AC GENERAL PURPOSE WIDEBAND OP-AMPS

OUTLINE DRAWING LB1031AC (Dimensions in Inches)



ORDERING INFORMATION:

DEVICE	COMCODE
LB1031AB	104368055
LB1031AC	104368063

A development of AT&T Bell Laboratories

For additional information contact your AT&T Account Manager, or call **1-800-372-2447**
 AT&T Technologies, 555 Union Boulevard, Dept. 50AL203140, Allentown, PA 18103

Printed in United States of America

DS87-132LBC-RD

008179 \swarrow \searrow \times \circ 8