K-AMP® HEARING AIDS *A PRACTICAL GUIDE*

BASIC K-AMP OPERATION

The K-AMP circuit has a level-dependent frequency response. It's automatic circuit will increase the gain and treble boost for quiet sounds, as illustrated in the 2cc coupler OUTPUT and GAIN curves in Figure #1 and #2.

In order for the K-AMP hearing aid to amplify only quiet sounds and become transparent (acoustically invisible) for loud sounds, the volume control needs to be set to about 1/3. At this setting the hearing aid will automatically provide about 25 dB of high-frequency gain for quiet sounds but 0 dB gain for loud sounds (a 90 dB input will result in 90 dB output). The curves shown here were obtained with the volume control set to 1/3.

A circuit modification called FFR (fixed frequency response) eliminates the automatic treble boost for quiet sounds but preserves the automatic gain increase for quiet sounds (see Figure #3). The FFR modification is typically used for flat or reverse-slope hearing losses.

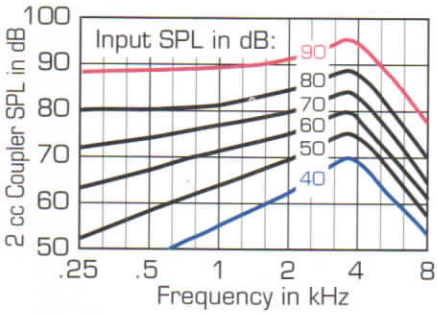


Figure #1
2cc Coupler Output Curves
Volume Control at 1/3

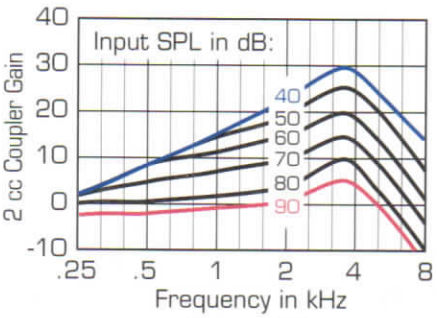


Figure #2
2cc Coupler Gain Curves
Volume Control at 1/3

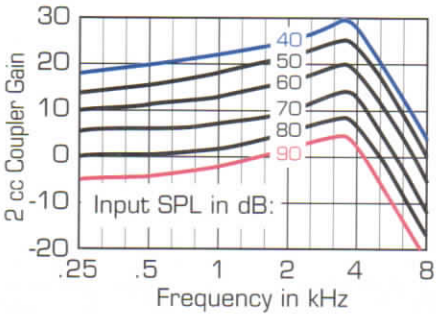
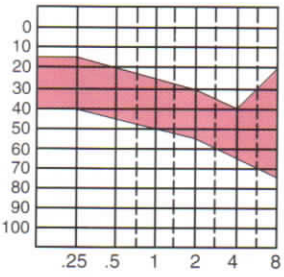


Figure #3
FFR Option
Volume Control at 1/3

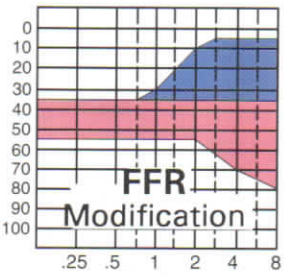
FITTING RANGE

The early enthusiastic reports on K-AMP hearing aids prompted us to suggest a fitting range that we now know includes some high-risk fittings. Many dispensers continue to have excellent success using K-AMP hearing aids even with these high-risk fittings, but our discussions with them indicate that a high level of sophistication in trimmer adjustment is required and counseling is very important for those cases.

Low Risk Fitting Ranges

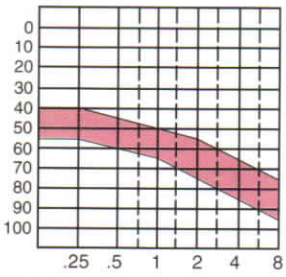


High Frequency Loss



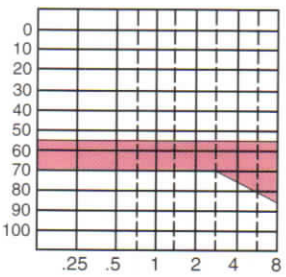
Flat or Reverse Loss

High Risk Fitting Ranges



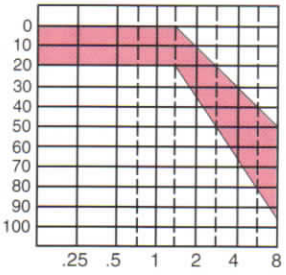
Moderate-Severe H.F Loss

- High power – specify SSPL-90 of 112-118 dB and HF FOG of 40-45 dB.
- Full concha ITE.
- Pressure vent or no vent.
- LFC & TK trimmers.



Moderate-Severe Flat Loss

- FFR circuit modification.
- High power – specify SSPL-90 of 112-118 dB and HF FOG of 40-45 dB.
- Full concha ITE.
- Pressure vent or no vent.
- LFC & TK trimmers.



Normal to 1-2 kHz

- Standard receiver.
- IROS not recommended for higher gain instruments.
- LFC & TK trimmers.
- Start with TK and LFC set to min.

K-AMP® HEARING AIDS — ADJUSTMENTS

VOLUME CONTROL

The volume control is used to control overall gain, allowing the user to choose some gain (or attenuation) for loud sounds. The volume control performs three important functions:

1. It increases gain for loud sounds for individuals with greater hearing loss.
2. It decreases gain for loud sounds for individuals with unusual sensitivity to loud sounds, and
3. It acts as a treble boost control when the LFC control is set toward minimum.

The automatic 25 dB increase in high-frequency gain for quiet sounds is unaffected by the volume control setting.

Figure #4 illustrates that:

a) With the volume control set to 1/3, the gain for loud sounds will be 0 dB and the high-frequency gain for quiet sounds will be 25 dB.

b) With the volume control set to full-on gain, the gain for loud sounds will increase to 20 dB while the high-frequency gain for quiet sounds will increase to 45 dB.

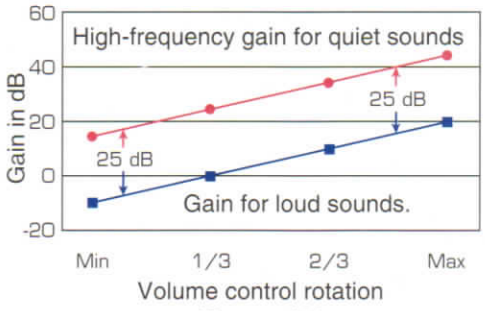


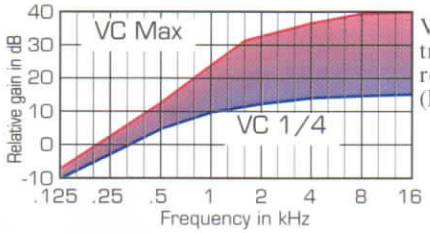
Figure #4

c) With the volume control set to *minimum*, the hearing aid will provide about 10 dB of *attenuation* for loud sounds and only 15 dB of high-frequency gain for quiet sounds. In this case the hearing aid acts as a combination hearing protector and mild-gain hearing aid.

NOTE: Special hearing-protection versions of the K-AMP hearing aid are available, offering up to 20 dB of attenuation for loud sounds when tightly sealed to the ear with no vent. The K-AMP circuit's distortion-free operation up to 110 dB SPL inputs makes it uniquely suited for this application.

LFC (LOW-FREQUENCY CONTROL) TRIMMER

Uses:
1. Adjust frequency response for increased clarity.
2. Improve sound quality of user's own voice.

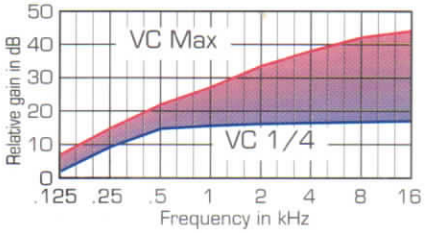


Volume control becomes treble boost control at reduced LFC settings (LFC minimum).

Figure #5

FFR circuit (LFC minimum).

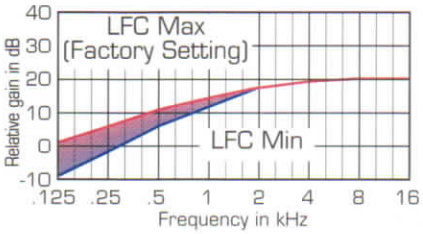
Figure #6

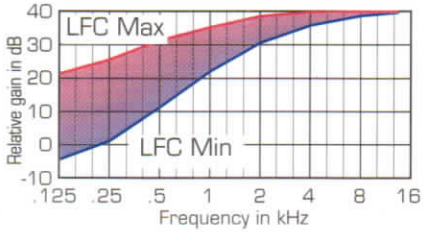


The LFC trimmer is normally wired so that it has maximum effect at the full-on volume control setting (see Figures #5-#8). The normal LFC wiring has the advantage that setting it to minimum (maximum low frequency cut) effectively turns the volume control into a treble boost control. This is true for both the standard circuit (Figure #5) and the FFR modification (Figure #6).

LFC has little effect at low volume control settings (VC = 1/3).

Figure #7





LFC has large effect at high volume control settings (VC = Max).

Figure #8

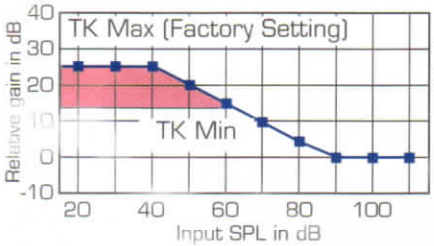
Figures #5 – #8 at 50 dB-SPL input.

TK (THRESHOLD KNEE) TRIMMER

Uses:
1. Reduce high-frequency gain in quiet by up to 12 dB for complaints of circuit noise.
2. Reduce feedback in quiet (at the expense of reduced high-frequency gain in quiet).

The threshold knee controlled by the TK trimmer is the lower threshold of compression, normally 40 dB SPL in the K-AMP hearing aid, adjustable up to 65 dB SPL.

At the maximum gain (factory) setting of the TK trimmer, the K-AMP circuit provides 25 dB more high-frequency gain for quiet sounds than for loud sounds (see Figure #9). At the minimum setting of the TK trimmer, the K-AMP circuit provides only about 13 dB more gain for quiet sounds than for loud sounds.



TK trimmer reduces HF gain in quiet up to 12 dB.

Figure #9

K-AMP® HEARING AIDS: COMMON FITTING PROBLEMS

COMPLAINT: **FEEDBACK (IN QUIET)**

Possible Cause: Leakage through the vent
Solution: Reduce the size of vent with inserts.

Possible Cause: Inadequate seal
Solution: Temporarily use foam E-A-R rings over the canal portion of the hearing aid. If feedback stops, the cause was indeed a poor fit. Recase.

Possible Cause: Unknown
Solution: Adjust the TK trimmer to reduce the gain in quiet. At minimum setting, the high-frequency gain is reduced 12 dB relative to maximum (factory) setting. (See TK trimmer section).

Counseling a lower volume control setting is often useful if the individual is attempting to obtain the loudness of a previous linear hearing aid.

COMPLAINT: **"CIRCUIT NOISE"**

Possible Cause: Amplified background noises
Solution 1: Verify by having the individual place a finger over the microphone opening to confirm that the noise disappears. If so, the individual is hearing the same sounds heard by those with normal hearing *but not yet localizing them normally*, so that the noise appears to be in the hearing aid. Users usually adapt Counsel.
Solution 2: Adjust TK trimmer to reduce high-frequency gain in quiet.

Possible Cause: Amplified microphone and background noise in the presence of normal hearing below 2 kHz
Solution 1: Adjust the LFC trimmer to reduce low-frequency amplification.
Solution 2: Adjust the LFC trimmer as above and adjust the TK trimmer to reduce gain in quiet.
Solution 3: *Start out* with both trimmers at minimum. Increase TK trimmer for better sensitivity in quiet after the individual has learned to sort out background sounds.
Solution 4: Counsel. Like tinnitus, this background noise will subjectively disappear over time in most cases.

COMPLAINT: **BACKGROUND NOISE**

Possible Cause: Increased audibility of all sounds

Solution: Counsel that the K-AMP doesn't filter out or suppress background noise. It is designed to make everything audible, as it is for normal listeners. As a result, understanding speech in background noise will be easier because the circuit automatically selects the right amount of gain and treble boost for the situation. Circuits that filter the noise typically degrade the clarity of speech in noise.

COMPLAINT: **TOO MANY SOUNDS**

Possible Cause: Volume control set too high
Solution: Counseling the individual to try less gain may be all that is required. The individual may be used to a linear hearing aid that makes loud sounds louder.

Possible Cause: Excessive high frequency gain for quiet sounds
Solution: Adjust the TK trimmer to reduce the gain for quiet sounds, which may eliminate the complaint at the risk of reducing the audibility of everyday sounds.

COMPLAINT: **LACK OF CLARITY**

Possible Cause: Insufficient Highs
Solution: Adjust the LFC trimmer to reduce lows, then readjust the volume control for comfortable listening. (Turning the LFC toward minimum in effect turns the volume control into a treble boost control.)

Counseling is sometimes useful: "Most tone controls only turn down the lows, but this both turns down the lows and gives increased highs when you advance the volume control."

COMPLAINT: **NOT LOUD ENOUGH**

Possible Cause: Insufficient gain overall even at full on gain
Solution 1 : Order a higher-power higher-gain EP-series Class D receiver. (Full concha ITE permits 3 dB greater microphone sensitivity).
Solution 2: Order a high-power CK receiver to provide even higher gain (50 dB HFA FOG at 50 dB SPL) and output (121 dB HFA SSPL-90) at the expense of a reduced bandwidth and somewhat higher battery drain.

Possible Cause: User accustomed to linear hearing aids
Solution: Counsel that the high-frequency overload distortion of his earlier (non-Class-D-receiver) hearing aids may have made them sound louder than a K-AMP aid with the same gain. "You need clarity, not loudness. You don't need loud sounds made louder, you only need soft sounds made louder."

Possible Cause: User wants more gain for loud sounds
Solution: If the gain for quiet sounds is adequate, an "LB trimmer" can be ordered on an experimental basis. Adjusting the LB trimmer will increase the gain for moderately-loud and loud sounds without affecting the gain for quiet sounds.

COMPLAINT: **OCCLUSION EFFECT**

Possible Cause: Insufficient venting
Solution: Increase venting but avoid IROS except in the case of mild loss. The occlusion effect (hollow voice) problem is hardly unique to K-AMP hearing aids, and the same tradeoff between venting and feedback applies.

Possible Cause: Highs and lows out of balance
Solution: Adjust the LFC trimmer to reduce lows and *increase highs* as the volume control is turned up. This may be successful in bringing the sound of the individual's voice into balance.

COMPLAINT: **FADING**

Possible Cause: Moisture buildup on a partially wax-clogged damper
Solution: Replace damper with Etymotic's damper-replacement tools.

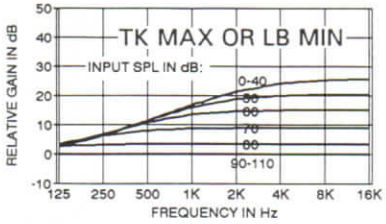
Possible Cause: Moisture buildup in partially clogged receiver
Solution: Replace receiver.
Prevention: It is a good idea to counsel the client *in advance* that the use of dampers smooths the sound, reduces the probability of feedback, and prevents expensive receiver failure, but that dampers generally require regular replacement.

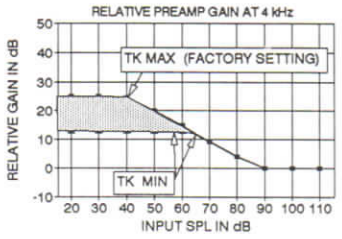
MISCELLANEOUS USEFUL INFORMATION

YOU DON'T HAVE TO READ THIS TO FIT K-AMP HEARING AIDS

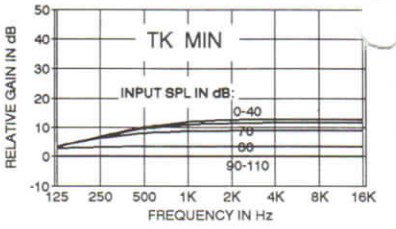
TK, LB (Loudness Boost)

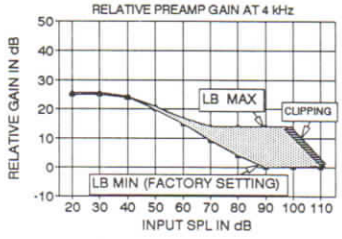
STANDARD K-AMP "TILL" CIRCUIT RESPONSE:
TK MAX OR **LB MIN**



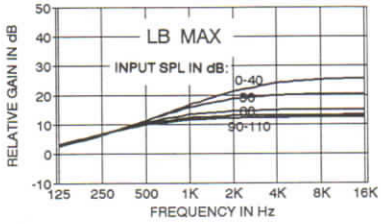


TK CUTS HF GAIN FOR QUIET SOUNDS UP TO 12 dB





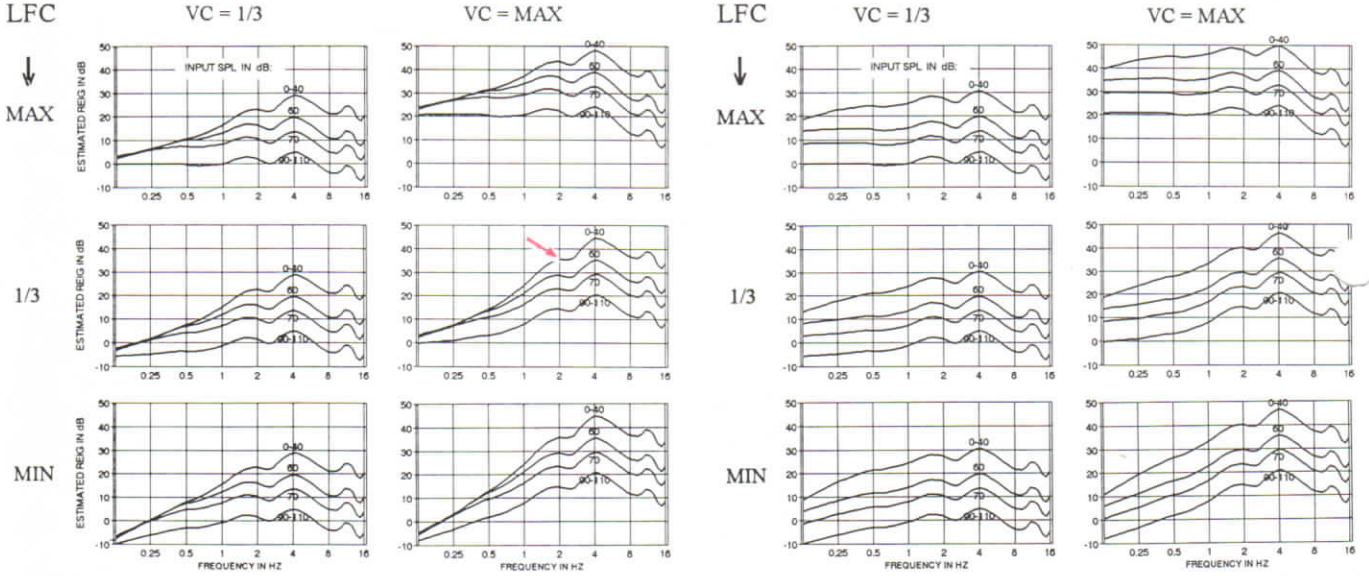
LB BOOSTS HF GAIN FOR LOUD SOUNDS UP TO 12 dB



EFFECT OF LFC (AND VC)

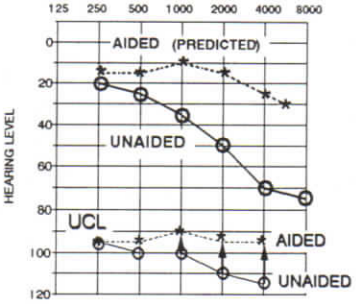
HIGH-FIDELITY K-AMP "TILL" RESPONSE

FFR CIRCUIT OPTION



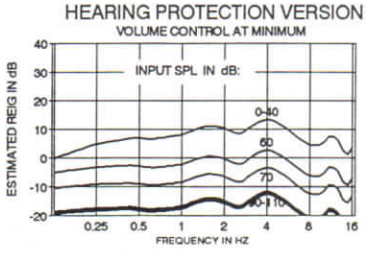
EXAMPLE: Use the 0-40 dB curve in the above graphs to predict aided thresholds for a given trimmer and volume control setting.
1. Choose LFC and VC setting. This example uses LFC = 1/3 and VC =MAX (see arrow).
2. To predict aided threshold, subtract the estimated REIG from the unaided threshold.
Ex: At 2 kHz on the audiogram at right, aided threshold is 50-35 = 15 dB.

Use the 90-110 dB curve for aided UCL calculations.



The hearing protection version of the K-AMP hearing aid requires special order.

At minimum VC setting, inputs of 90-110 dB SPL will be attenuated approximately 15 dB.

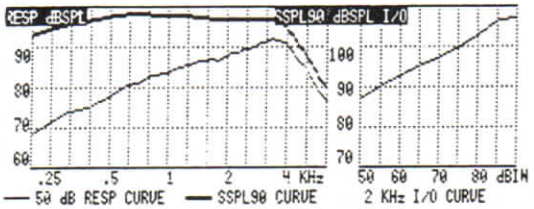


TYPICAL 2CC COUPLER test results for **high fidelity** K-AMP hearing aids using standard receivers. Add 5 dB to both gain and SSPL-90 curves for high-power high-fidelity versions.

Use of a CK receiver will provide up to 50 dB HFA FOG and 121 dB HFA SSPL-90 at the expense of a reduced bandwidth.

ANSI S3.22-1982
AGC TYPE AIG
F.O.G. AT 50 dB

TYPICAL FINAL TEST RESULTS, VOLUME CONTROL SET TO F. O. G.



MAX SSPL90: 108.5 dB	RESP LIMIT: 66.5 dB
AT: 800 Hz	F1= 200 Hz F2=8000 Hz
HF AVG: 107.4 dB	THD FREQ SRC
HF AVG FULL ON GAIN:	1.1 % 500 Hz 70 dB
AT 50 dB IN 36.8dB	1.1 % 800 Hz 70 dB
REFERENCE TEST GAIN:	2.1 % 1600 Hz 65 dB
36.8dB	EQ INP NOISE: 27.4 dB
	BAT (1.5 V) 0.0 MA

Real ear measurements should be done using 50 dB SPL and 90 dB SPL test levels.