

CARVER

MODEL C 4 0 0 0

Preliminary

USER'S MANUAL

TABLE OF CONTENTS

	Page
Specifications.....	3
Introduction.....	4
Installation.....	5
Basic Controls and Functions.....	8
Special Controls.....	10
Peak Unlimiter.....	10
Auto Correlator.....	11
Time Delay.....	12
SONIC HOLOGRAM GENERATOR _{tm}	14
Helpful Hints.....	32

In quest for better sound reproduction audio components have been refined and sophisticated. Yet the differences between the finest components are minute and often illusory and none of them significantly affect the realism of performance. The specifications associated with "state of the art" are significant only within the scope of the traditional audio establishment.

Until now!

The Carver C-4000 is an audio component without precedent. What it can achieve separates it from all other components and direct comparison is possible for only a portion of its capabilities. It combines six separate functions to recreate music in a way never believed possible.

Start with the preamplifier. The C-4000 commands attention for its flawless sonic qualities -- a benefit of experience with redefining the state of art. The FET phono section is accurate to .25dB of the extended RIAA standard and it cannot be overloaded by signals below 1500 millivolts at 20 khz! Each circuit stage of the C-4000 is ultra fast so that there is absolutely no slew limiting and TIM is unmeasurable.

There are separate tone controls for each channel augmented by a choice of turnover frequency and a defeat for instant comparison and laboratory-flat response. An 18dB/octave infrasonic filter conceals the effects of power-robbing rumble and record warps. In addition to tape monitoring and separate dubbing for two tape decks there is provision for an external processor. Speakers can be switched off at the C-4000 if the powered headphone jack is preferred.

The C-4000 goes beyond state of the art performance and control flexibility. It can improve the sound quality of recorded music. The third generation Autocorrelator discriminates between the waveforms of music and noise to reduce rumble and hiss by up to 8dB with no effect on delicate high frequencies and definition. It has the option of computer-assisted automatic calibration. Dynamic range, so frequently restricted by recording or broadcast engineers is restored by the Peak Unlimiter. Music played through the C-4000 is more vivid, freed from the compromises of its recording medium.

All of this innovation is but the point of departure for the C-4000. It achieves a totally unique realism by freeing the music from the boundaries of the loudspeakers. Carver Corporation has invented the Sonic Hologram Generator which recreates the precise sense of space in which a recording has been made. You can locate each instrument and voice exactly where it was recorded -- even if it seems to come from far beyond, off to the sides or in front of your loudspeakers! This process is called Sonic Holography because a true three-dimensional and totally convincing image is created using only two loudspeakers and conventional records, tapes or broadcasts! It is impossible to describe the experience and we invite your audition. We think you should know that every respected audio authority and reviewer has been impressed; the skepticism we expected has become astonished belief and endorsement.

The very finest stereo will never be adequate after experiencing the C-4000 Sonic Holography.

The final touch to achieve ultimate realism is a sophisticated Time Delay system that enables you to substitute the sense of the space where the music was recorded for the confines of your room. The five primary delays and choice of initial delay offer reverberant field that frees the sound from your own room's walls and ceiling. There are controls for both echo density and level of a wideband circuit that extends octaves beyond its competitors. And if that were not enough there are three amplifiers with outputs totalling 40 watts RMS to make additional (and costly) amplifiers unnecessary. The full effect only requires small loudspeakers of modest cost. In combination with the Sonic Hologram Generator the effect is stunning and not possible to achieve with any other combination of components, regardless of cost.

State of the art preamplifier specifications, Autocorrelator noise reduction, Peak Unlimiter dynamic range correction, versatile control, Sonic Hologram Generator, Time Delay and built in amplifiers add up to the Carver C-4000.

And music reproduction will never be the same.

SPECIFICATIONS

Phono Stage

RIAA: $+0.25$ dB "extended" RIAA curve
Overload: 150 millivolts at 1000 Hz
1500 millivolts at 20,000 Hz

High Level Stage

Frequency response: 5Hz to 200 kHz

Infrasonic Filter

18 dB per octave below 20 Hz
Autocorrelator
Noise reduction is approximately 8 dB from 2.5 kHz to 20 kHz. Low frequency noise reduction from 200 Hz to 20 Hz, averaging 10 dB.

Sonic Hologram generator

Image resolution: Better than 5° arc in the horizontal plane, better than 20° of arc in the vertical plane. (Holographic injection ratio set to theoretical)

Peak Unlimiter--Downward Expander

Total dynamic range recovery: Approximate 6dB. (Double the dynamic range)

Time Delay System

Delay time: Switch selectable, up to 50 milliseconds.
Distortion: Less than .25%
Bandwidth: 20kHz with feed forward to 19 kHz.
Echo density: Variable from only a single reflection to 6800 reflections per second.
Outputs: Amplitude and phase randomized. Left back, right back, front center. A built-in power amplifier provides a combined output of 40 watts.

C 4000

INTRODUCTION

Your new Carver C-4000 is the most advanced preamplifier available for the flawless reproduction of music. Its unique features are based on newly developed Carver theory and technology that has moved beyond the conventional definition of "state of the art". Starting with rigorous performance specifications, the C-4000 frees music from dynamic and spatial constraints of the recorded medium and listening room. The performance of the C-4000 is not limited to its accuracy, for ultimately its achievement is in approaching reality.

Before proceeding please read through this manual thoroughly. The C-4000 is probably the most sophisticated component you'll ever own and it incorporates a number of functions that you should be familiar with to explore its full potential.

We have engineered and crafted the C-4000 for your total satisfaction. We feel that your understanding will assure enjoyment for years to come.

PRIOR TO INSTALLATION

Carefully remove the C-4000 from its packing. It is important to save the carton and all packing materials as this is the safest protection if you need to move or return the unit for servicing.

Make a note of the serial number which is located on the rear of the C-4000. Record it in the space provided here for convenient reference. You will need to refer to this number in the event you require service or if it is stolen.

INSTALLATION

Locate the C-4000 on a solid smooth surface where it is convenient to reach its controls. You should attempt to locate the C-4000 so that the cables from your turntable(s) do not require adding extensions.

To protect your system make all your connections before plugging in the AC cord. This is important!

BASIC HOOKUP

Use high quality, shielded cables and make certain the plugs are inserted firmly in the jacks both on the C-4000 and associated components.

It is possible to run cables up to 20 feet from the C-4000 to the power amplifier without affecting performance.

PHONO

There are two sets of phone connections to accommodate separate turntables or tonearms. Each has a standard 47KR termination. Phono 1 has trim adjustment to optimize cartridge frequency response. Three values of capacitance are provided by this adjacent switch. This value is added to the capacitance of the turntable's arm wiring and cables. By comparing the cartridge manufacturer's recommendation and turntable manufacturer's data you can approximate the sum that produces best results. (Listen to it! More capacitance reduces highs, adjust so it sounds right to you.) For moving coil cartridges, use a Carver preamp between the turntables either phono 1 or phono 2 input.

GROUNDING

Firmly fasten the separate ground leads from the turntables to the ground terminal. You may later find that the hum level is lower with the ground wire (s) disconnected, but this is rarely the case. The ground terminal is not used for any connections other than the turntable(s).

TUNER

Connect to the tuner's output jacks. If your tuner has an output level control you may later adjust it so that volume is the same as your turntable(s). This will save you from having to change system volume on the C-4000 each time you change source.

TAPE DECKS

These connect both to input and output jacks. The output from each deck connects to the tape input jacks on the C-4000 and the input on each deck to the tape output jacks. Be sure one recorder is attached to tape 1 input and tape 1 output while the other is attached to tape 2 input and tape 2 output.

It is also possible to use AUX1 and AUX2 jacks for playback of additional tape equipment, although independent dubbing or copying is not possible.

OTHER SOURCES

A TV tuner can be attached to the AUX1 or AUX2 jacks. You should consult your Carver dealer if you have any doubt regarding the signal compatibility of other sources.

ACCESSORIES

Other forms of signal processor may be attached to the C-4000 via the external processor jacks. Examples are graphic and parametric equalizers, dbx and Dolby noise reduction units, and equalizers for specific speaker systems such as the Bose 901 series, the bass computer for the KLH 1, 2, and 3 or Infinity Reference 4.5 and 2.5. In this fashion the signal flow is routed through the device when the "external processor" push button is depressed. This affects signals appearing at the main output jacks, but not at the tape recording terminals.

OUTPUT

The main output jacks on the C-4000 are connected to the input jacks on the power amplifier. If the system has been bi-amped using an electronic dividing network, then the outputs of the C-4000 are connected to the input jacks of the dividing network.

AC OUTLETS

The C-4000 has three switched and three unswitched convenience outlets. The switched outlets are "live" when the C-4000 is switched on. Thus, you can control equipment such as the power amplifier and turner simultaneously. The unswitched outlets are intended for turntables and tape decks whose functions do not automatically start with turn on. The unswitched outlets can also be used for equipment that must remain on all the time to avoid turn on transients (or "thumps"). An example might be an equalizer or pre-preamp.

LOUDSPEAKERS

The C-4000 has three sets of speaker terminals for its built-in time delay amplifiers. Each loudspeaker should have an impedance no lower than 4 ohm and power handling of at least 15 watts RMS. These terminals are spaced closely and you must observe all the normal precautions about avoiding short circuit or out of phase connections.

Speaker connections are made by stripping $\frac{1}{4}$ " of insulation off each conductor and twisting the exposed strands of each tightly. Make a "C" shaped loop of each bare wire. Loosen the appropriate terminal screw and slip the loop around the shaft, then tighten it down on the wire. Make certain that no strands have been "squeezed out" and are touching between wires or terminals.

Each speaker has + and - connections normally indicated by a red terminal or "8 ohm" for + and black terminal, "0" or "common" for -. Each should be connected the same way to the C-4000. This is facilitated by the markings on insulation. Other wire may use silver and copper colored wires visible through transparent insulation.

LOUDSPEAKER SELECTION AND PLACEMENT

See Time Delay and Sonic Hologram

OPERATING THE C-4000

Basic Controls and Functions

Before switching on the power there are a few preliminary settings you should make to avoid unpleasant surprises; turn the volume knob all the way down, set the balance control at its midpoint and set the selector knob for the source you wish to listen to. Make certain all the pushswitches are in their outer off positions. Now, push the power switch on and allow 5 to 10 seconds for your power amplifier to activate and stabilize.

Now raise the volume to the desired listening level and adjust the balance so a symmetrical stereo image is presented at your favorite listening area.

Tone Controls

Each channel has separate bass and treble controls whose functions are controlled by the top three pushswitches. They only operate when the tone switch is depressed. This allows you to adjust them to taste and then make instant comparisons to a "flat" or unadjusted response.

The range of the treble controls is selected by the 8kHz/2kHz switch. In the outer 8kHz position, the controls affect only higher frequency portions and are more subtle in their action. In the inner 2kHz range, controls cut and boost two additional octaves and their effect is far more obvious.

The range of the bass controls is similarly selected by the 40Hz/Loudness switch. In the outer 40Hz position, only extremely low bass frequencies are effected. Unless your speakers are capable of honest extended bass response, its effect may be hard to discern. In the inner Loudness position, two more octaves are effected and the effect is far more obvious; with boost following the traditional Loudness curve.

It is desirable to experiment, but you should be aware of your speaker's and amplifier's limitations. Full boost of either bass or treble may call for more energy than the power amplifier can deliver or the speakers can accommodate without damage.

The low midrange trim switch functions as a sort of room equalizer. It slightly reduces output in the same range that is frequently slightly emphasized due to speaker/room boundary effects. Its effect is mild, but can restore balance to voices that sound too "Chesty" or instruments that sound too "rich".

You will find this trim capability particularly useful on certain recordings when using the Sonic Holography circuitry, (see section on Sonic Hologram Generator).

The infrasonic filter can be thought of as a tone control, even though its action is inaudible. It provides a sharp cutoff of frequencies that are generated below audibility but that still can drain a power amplifier's reserves.

By suppressing low frequency components of rumble, record warp, needle set down or feedback, the ultrasonic filter allows more power to remain available for audible reproduction and reduces IM distortion.

It is good practice to leave the infrasonic filter switched on at all times.

The stereo/mono switch parallels both channels when it is pressed in.

This is useful for listening through both speakers to a mono source such as a TV tuner, connected to either the left or right channels.

The output/-20dB switch is a convenient way to reduce and exactly restore output level. It is useful if you answer the telephone and then wish to resume your previous listening volume.

It is also useful if your power amplifier is extremely sensitive so that you can use the volume control of the C-4000 in its mid-rotation area.

The speakers/off switch shuts off the output at the main output jacks only. It has no effect on the built in time delay circuitis which are separately switched nor on the tape recording output. It is provided so that private headphone listening is possible without operating the speakers.

Tape monitor 1 allows playback of a tape deck attached to the Tape 1 input jacks. If the deck is a three head model it allows instant comparisons to verify the quality of the recording and avoid disappointment. If nothing is connected to this circuit pushing the switch will cut out all sound at the main headphone and time delay outputs.

Tape monitor 2 provides identical functions for a second tape deck.

DUB1 - 2 Allows for direct recording to be made without it being necessary to listen to either deck. In this case deck 1 is the playback deck and deck 2 is the recording deck.

DUB2 - 1 Provides the same function except that deck 2 is the playback deck and deck 1 is the recording deck.

In order to dub and listen simply press the appropriate dub switch and monitor switch. This way you can listen to the output of the playback deck, switch to the input of the record deck and then switch to the monitor output of the record deck.

The external processor switch makes it possible to activate an accessory whose input overload range restricts it from being used between the output of the C-4000 and the power amplifier. If it is used with an equalizer, it can also provide an instant comparison between equalized and "flat" response by pushing in and out.

SPECIAL CONTROLS

Peak Unlimiter

Almost all recorded music has its dynamic range constricted to "fit" the limitations of record grooves or broadcast modulation. This has the affect of taking life out of the music by raising the volume during the quieter passages and lowering the volume during crecendos. The peak unlimit switch activates circuitry that senses such compression and restores the dynamic range intended by the composer or performer.

The unlimit threshold control lets you adjust its operation so that only the compressed peaks are restored and the circuit is not exaggerating uncompressed volume too. Starting at the midpoint carefully turn the knob so that the adjacent LED just flashes on brief musical crescendos or peaks. If it remains on more frequently it is appropriate to turn the knob counter clockwise.

The effect of this circuit is quite dramatic. If your power amplifier has power meters or LED's you may see as well as hear the tremendous difference in power by restoring dynamic range.

Auto Correlator

This Carver-patented circuit removes 8dB of background noise from any source without the requirement of special encoding. It discriminates between waveforms typical of music and random waveforms of noise. It constantly compares and computes what can pass and what must be blocked over a wide range of frequencies. Press the autocorrelator switch to activate the circuit. For most recordings or broadcasts, also press the correlation/auto threshold switch. An on-board computer will track the requirements of the music and adjust the circuit by itself. The adjacent LED indicates its operation. For manual operation, release the correlation auto threshold switch. Listen to a sample of the music and turn the control counter-clockwise until you just hear the hiss noise diminish. Turn slightly further and you will hear a muffling of the high frequencies. Turn the control back to restore the high frequencies, but not so far as to restore the unwanted hiss.

The appreciation of the autocorrelator will require some listening experience. You may sense a loss of "highs" even though we can assure you that frequency response is unaffected! This is due to psycho-acoustic effect where our hearing mechanism equates the presence of high frequency noise content with "definition" or "airiness" of the source itself. After you have lived with the autocorrelator for awhile, you will be offended by the noise you had endured before.

The C-4000 also provides a low frequency range to suppress turntable rumble and resonant peaks. This is set once for the turntable with which you do your most serious listening. The screw driver adjustment marked L.F. Cal is rotated while you are playing a record. The lead in or guard bands between selections are a good source. Adjust the control counterclockwise until you hear a reduction of noise. There should be no audible effect on the music itself.

ALTERNATE LOW FREQUENCY CALIBRATION ADJUSTMENT PROCEDURE

Many good quality cartridge-turntable combinations yield so little hum or rumble that adjusting the L F Cal control according to the above procedure becomes very difficult, if not impossible. For this situation we offer the following procedure:

- 1) Set the preamp tone controls for mild base boost.
- 2) Switch the Correlator circuit IN.
- 3) Rotate the L F Cal adjustment FULLY CLOCKWISE.
- 4) Play a record which contains suitable bass material.
- 5) Rotate the L F Cal adjustment FULLY COUNTERCLOCKWISE. Verify that there is a noticeable decrease in bass response.
- 6) Slowly rotate the L F Cal adjustment CLOCKWISE until the bass response increases back to the original level - stop rotating at this point.
- 7) Now rotate the L F Cal adjustment further clockwise about 1/8 turn further past the point reached in Step 6.

The L F Cal should now be in proper adjustment. Readjustment may be necessary if the cartridge is changed or a low-level recording is encountered.

Time Delay

The C-4000 time delay circuitry recreates the sense of space in which music is performed. The human hearing mechanism judges the size of a space by comparing the sound reaching us directly with the delayed sound from various reflections off the walls and ceiling. In a listening room our sense of spaciousness is restricted to the short delays of reflections of the room's walls and ceiling.

The C-4000 time delay delays the audio signal by first storing it electronically in sophisticated devices call "CCD". This delayed signal is then contoured so that its response simulates the effect of high frequency attenuation that occurs due to absorption by the reflective surfaces in a live listening environment. It is then amplified and reproduced by three small loudspeakers. These loudspeakers are positioned near the front and to the rear sides of the listening room so that their delayed signals simulate the reflections from the walls of a far larger environment, such as a concert hall. This effect is so convincing that the walls of the room itself seem to vanish, yielding to the sense of space approximating the original.

Because the three supplementary speakers are only required to reproduce a limited frequency range and the volume of reflected signal they need not be large or expensive. The most important criteria is that they have low distortion and that their midrange response is smooth and as close as possible to your two primary loudspeakers. (Which we hope are as good as you can afford).

Placement will undoubtedly require some experimentation depending on your room arrangement and where you sit for serious listening. This diagram is our recommendation starting point:

To activate the time delay, depress the time delay pushswitch. The time delay echo density and time delay output level should be fully counter-clockwise and the 35/50 msec switch in its outer position. Now gradually advance the time delay output level so the sound from the supplementary speakers is evident but still much lower in volume than the primary speakers. Too high a proportion of echo will sound artificial. Now advance the echo density knob until the echos seem to blend with the main signal and a sense of depth is created without drawing attention from the primary signal. If you wish to simulate an environment rich with echos, such as a church, you would add more echo density. The 50/80 msec switch controls the delay time for the first reflection and thus, the size of the space desired. The bigger the space the longer the reflection is delayed. The outer, 35 msec, position is effective for most environments, the inner, 50 msec, position for a cathedral or very large auditorium.

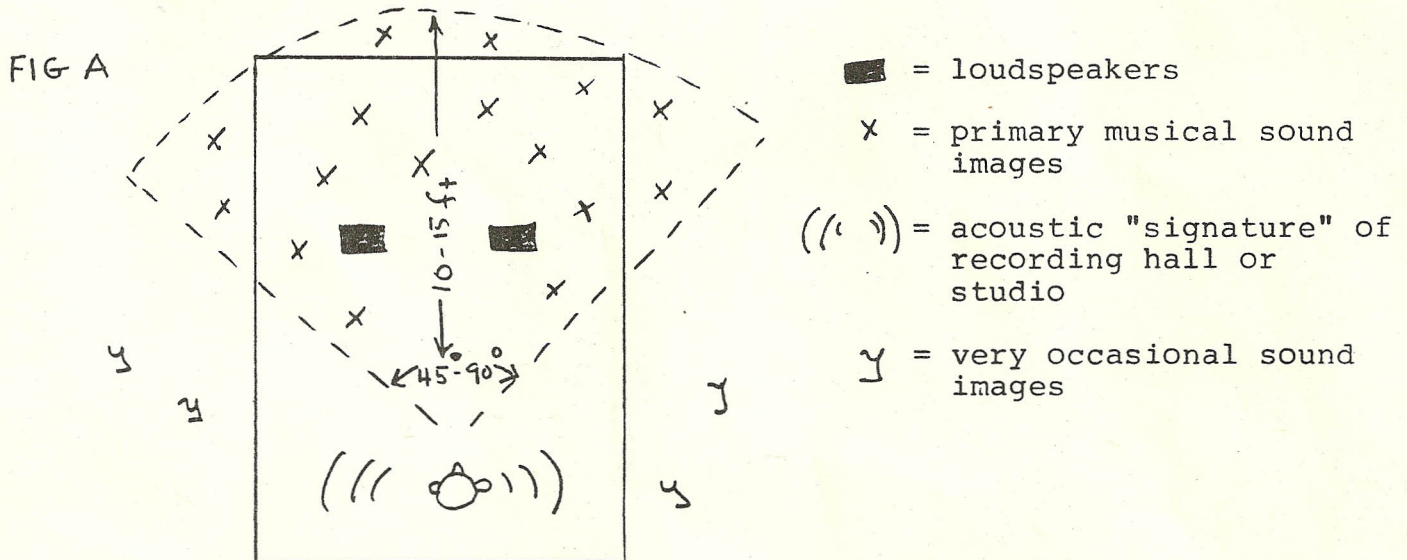
THE SONIC HOLOGRAM GENERATOR

The Carver Sonic Hologram Generator is a method of freeing music from the spatial constraints of the listening room and the loudspeakers. Whereas the Time Delay adds a sense of ambience and depth characteristic of the recording environment, the Sonic Hologram Generator creates a sonic illusion that is so believable, and so convincing, that the listener can pinpoint the locations of instruments and performers even if they seem to come from a space beyond the room's walls, in front of or in back of the speakers. (Figure 3). It is a three-dimensional sonic representation that gives "substance" to performers by describing them more fully.

We have found that it generally requires about four to six hours of "hands on" experience with the Sonic Hologram Generator to get it working properly. Anticipate that your initial efforts may be discouraging. (The Holographic image will not develop in your room). However, as you carefully follow the instructions outlined in this section, you will learn how to "make it work", what to expect, how to tell when it is functioning properly, and what steps to take in order to elicit the maximum amount of realism from the Sonic Hologram.

THE PROPERLY FUNCTIONING HOLOGRAPHIC IMAGE

At this point, we are going to describe, in words, the sound field of a properly operating Sonic Hologram. Consider the diagram (fig. A).



The musical instruments will be spread in a large proscenium arc in front of you. The angle will range from 45° to 90° .

Sound images will exist to the left and to the right, well beyond the limits of the loudspeakers. A very occasional sound image may exist all the way to your right or to your left. The "front-to-back" or "stage" depth will be from 10 to 20 feet in front of you, with sound images clearly floating in space behind, and from time to time, in front of the loudspeakers. You can turn your head to "look" at the sound images and they will stay "put" in space. Sound images will clearly emerge from beyond the limits of the room boundaries. At your listening position, and from all around you, including over your shoulders, you will sense, (and this is very hard to describe) an almost palpable "feel" of the space or "sonic signature" that belongs to the concert hall or recording studio. This sense of the hall seems to be related to very low frequency standing-wave energy, and seems to be a different sort of space than that developed by the time delay system. The complete illusion will be convincing, believable and well defined.

The above description of the sound field applies only to the Sonic Hologram Generator and without the use of the Time Delay system. The Time Delay function is used, in very small amounts, together with the Sonic Hologram; the result is an illusion of greater hall size and increased realism.

INSTALLATION AND SET-UP

Proper functioning of the Sonic Hologram Generator is dependent on a more total control of factors that are not as significant for ordinary or time-delay enhanced stereo. Some requirements may seem contrary to your experience for speaker placement.

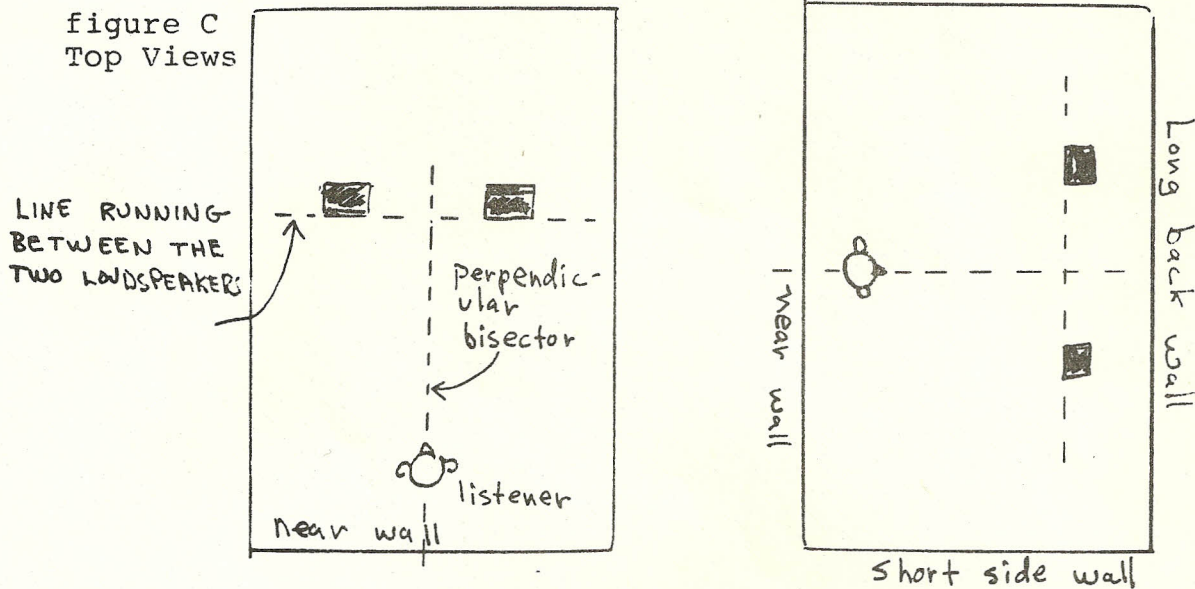
The Sonic Hologram is a fragile image that is easily diluted or destroyed if the sound from the main loudspeakers does not reach the listener in a specified way. Unwanted reflections from the boundaries of the listening room and/or the loudspeaker baffle board can impede correct operation. Some experimentation is going to be necessary before correct results can be achieved. Do not be discouraged if your first efforts create an image that behaves more or less like ordinary stereo, perhaps with exaggerated bass.

INITIAL SET-UP

The purpose of this section is to become acquainted with the Sonic Hologram Generator.

Step 1 Temporarily place your main loudspeakers into your listening room in such a way that they are away from reflective surfaces. Several feet from the side walls and several feet from the back wall will do nicely. Refer to figure C. Place the speakers about 3 to 7 feet apart, depending on your room size. Use speaker stands if available. This is important.

figure C
Top Views



Obtain a chair that can easily be moved about, and place it in a position as shown at the listener. As carefully as you can, have the chair on the perpendicular bisector of the line running between the two loudspeakers. This imaginary line is called the "preferred axis". Ideally, the listener should have a wall behind him approximately 1 to 4 feet.

Step 2 Refer to the preamplifier front panel.

- A) TONE button "in".
- B) BASS controls 9 o'clock.
- C) INFRASONIC-FILTER button "in".
- D) 40 Hz-LOUDNESS button "in"
- E) HOLOGRAPHIC INJECTION RATIO button "in". (Theoretical)
- F) All other buttons "out"
- G) VOLUME control at minimum.
- H) SELECTOR switch at PHONO 1 or PHONO 2.

Step 3 Refer to the back panel.

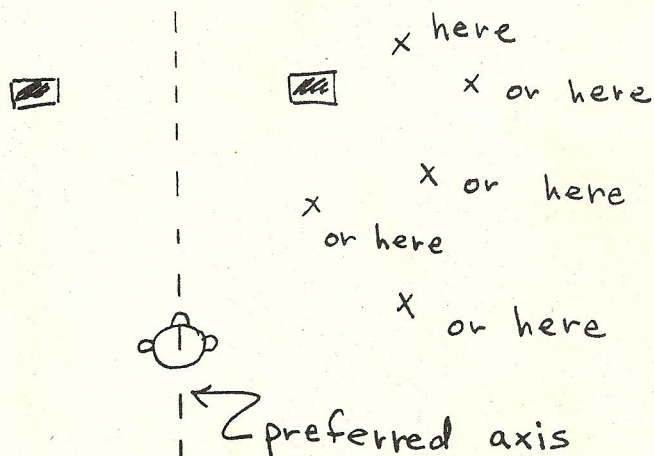
- A) PHONO 1 LOADING any position.
- B) HOLOGRAPHIC LISTENING ANGLE. "normal"

Step 4 Play a record of a human voice singing with musical accompaniment. (Voices are good for this procedure). The object of what follows is to find the exact preferred axis to within one inch, and to cause the visual preferred axis to be the same as the acoustic preferred axis. More about the distinction between the two later.

Step 5 Verify that the whole system works as a standard stereo system. Pay close attention to the phasing of your loudspeakers and that the right channel is the right channel and not inadvertently reversed. If the phasing of one of loudspeakers is reversed, the Sonic Hologram Generator will

not operate. It will make sound, but the holographic image will not develop. Resist the temptation to push the Sonic Hologram Generator button at this time. If you do, nothing much will happen.

- Step 6 Turn down the volume control.
- Step 7 Unplug the left phono input. Leave the right phono plugged in. Push the Sonic Hologram Generator button "in".
- Step 8 Play record at a soft to moderate volume. Walk up to each loudspeaker, place your ear close to each loudspeaker in turn, and verify that both loudspeakers are playing the program material.
- Step 9 Go sit in your listening chair.
- Step 10 Very slowly move your head from side to side about a foot or so. You are seeking the preferred axis. As your head slowly passes through the preferred axis, the sound image will move away from the loudspeakers far to the right of the right loudspeaker. It may appear in front of, or behind the plane of the speaker. When your head is not centered on the preferred axis, the sound will appear to come from the vicinity of the speakers. Once you have found the preferred axis and the sound image is clearly over on the right side beyond the loudspeaker, move the chair as necessary so you can sit in it up straight and hear the sound off to the right. Diagramed below shows where the sound should come from.



Put a piece of tape on the floor showing the center of the chair. Don't move the chair.

- Step 11 Turn down the volume. Plug the left phono back in. Unplug the right phono. Play the music. Sit in the chair.

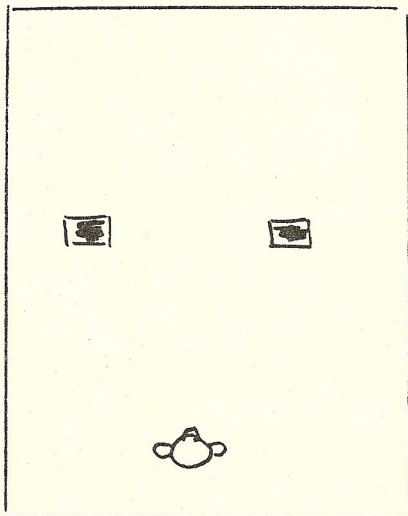
The sound should now come from off to the left of the left speaker.

- Step 12 Turn down the volume. Restore BASS controls to their mid (flat) positions. Plug in both phono leads and go sit in the chair. The holographic image, or Sonic Hologram, should now be spread out in a wide arc in front of you with lots of front-to-back depth. It should be similar to the description given at the beginning of this section. If it is only part way "there", that is o.k. for now.
- Step 13 Push the TIME DELAY button "in". ECHO DENSITY control at minimum. 35 MS button out. Rotate TIME DELAY OUTPUT LEVEL until you can just begin to hear an increase in richness and realism. This is the correct setting for most music and voice. Go easy on the amount of time delay.
- Step 14 Sit in your chair and enjoy a sound quality we are quite certain you have never before experienced in your room.

FINE TUNING THE HOLOGRAPHIC IMAGE

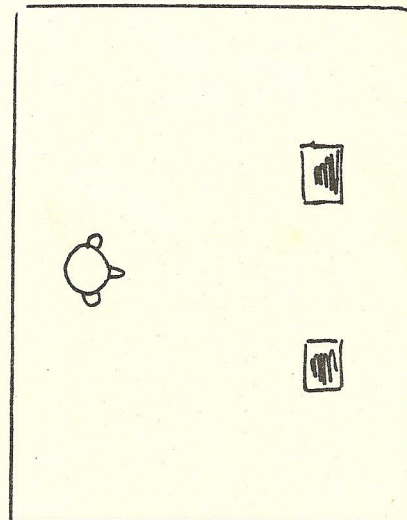
After you have listened to several musical selections, and have some experience with the Sonic Hologram, you are in a position to "fine tune" the system. The interplay between room acoustics and speaker characteristics is complex so please read through all of the following recommendations. The first, and most easily done, is to adjust the low frequency balance of the system. In a large room with high ceilings, the amount of low frequency energy will seem, psychoacoustically, to remain constant when the Sonic Hologram Generator button is depressed. In a smaller room, with lower ceilings, standing waves may develop that serve to emphasize the low frequency energy. A similar event occurs when the Time Delay system is used. In many cases, the increase in bass energy will result in an added sense of "warmth" to the sound and may be a welcome quality. In other cases, the increase may cause an unpleasant low frequency exaggeration. The tone controls have been especially designed to help cope with this event. In the boost positions, the controls behave like standard controls. However, in the cut position, they have a shelving characteristic that has been specifically designed to restore the correct low frequency balance in the event standing waves cause an exaggerated bass. In general, with the TONE, -2dB TRIM, and the 40Hz buttons depressed, some experimentation with the bass controls in the cut position will easily restore the proper low frequency balance. The -2dB TRIM is independent of the tone controls.

The next step in fine tuning the Sonic Hologram is to experiment with loudspeaker location. The object here is to reach a point where esthetic considerations relative to listening room decor and the Sonic Hologram performance can happily co-exist. Shown below are two ideal, if not fully practical, for best operation of the Sonic Hologram.



(1)

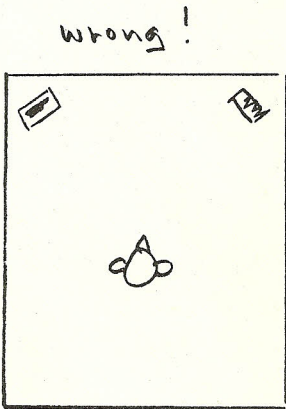
OR



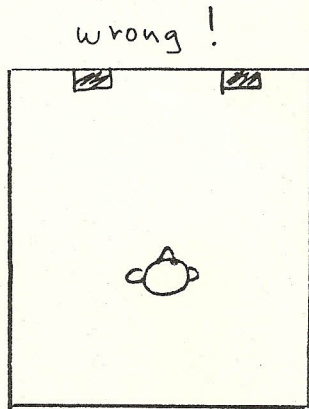
(2)

The installation shown in figure 1 will yield a large front-to-back depth and moderate stage width. The installation in figure 2 will yield a very wide stage width with more moderate front-to-back depth.

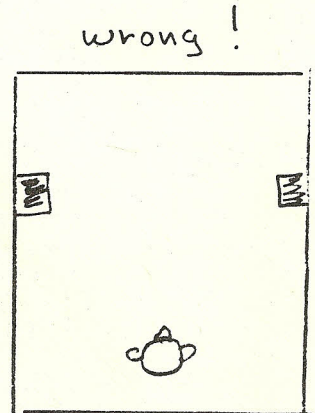
Shown below in figures 3, 4, 5 and 6 are speaker placements that are common to ordinary stereo applications, but will not work properly with the Sonic Hologram. Figure 7 will work well. Especially if sound absorbent padding is used.



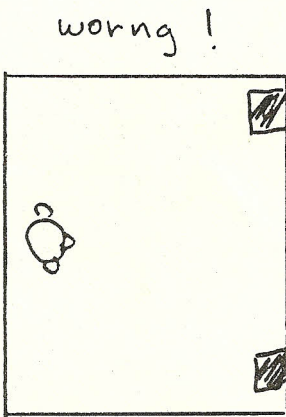
(3)



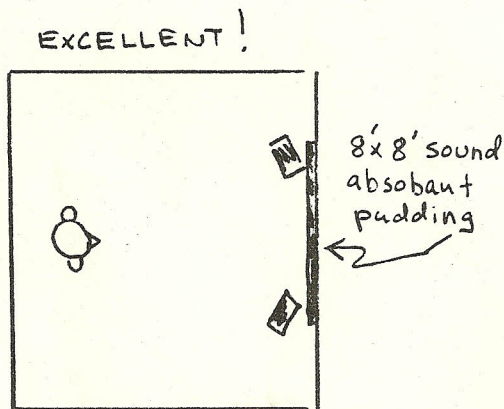
(4)



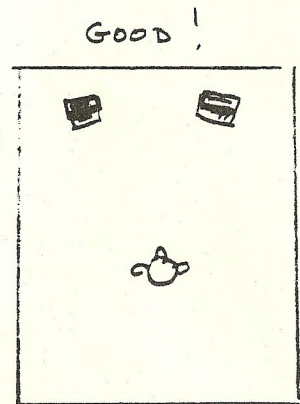
(5)



(6)



(7)



(8)

loudspeakers
angled inward

The difficulty with installations 3,4,5, and 6 is that in each case, sound wave reflections from the boundaries of the listening room will severely dilute, or even destroy, the illusion of the Sonic Hologram. Why this is so will be discussed in the second part of this section. As you can see, figure 1 places the speakers away from the walls, especially the rear walls in order to minimize reflections. Reflections that would just barely harm an ordinary stereo image can easily destroy the Holographic Stereo image.

Lets take a look at installation number 1, an ideal, if not fully practical installation in most listening rooms. There are several things that combine to make this setup excellent. First, the speakers are located away from the side walls, so as to minimize reflections from the side. Also, they are located away from the rear wall, also minimizing reflections. Secondly, the listener is situated so that he is close to a near wall and immersed in a sound field that is made up of direct sound from the speakers and reflected sound from the near wall behind him.

Figure (7) is an excellent choice. The speakers are located away from the side walls. The listener has behind him a reflective wall. The reflective wall behind the listener will serve to increase the front-to-back image. The loudspeakers are sharply angled toward the listener. This helps to increase front-to-back depth, and also to minimize the amount of the side wall reflections.

The loudspeakers are one foot away from the wall. The sound absorbing padding causes the Sonic Hologram to "think" that there is a large space behind the speakers; this "virtual" space gives the holographic image a place in which to build and to occupy. The padding is optional; it serves to increase front-to-back depth.

THE SONIC HOLOGRAM GENERATOR CONTROLS

In addition to the button that switches the Sonic Hologram Generator into the circuit, there are two other switches.

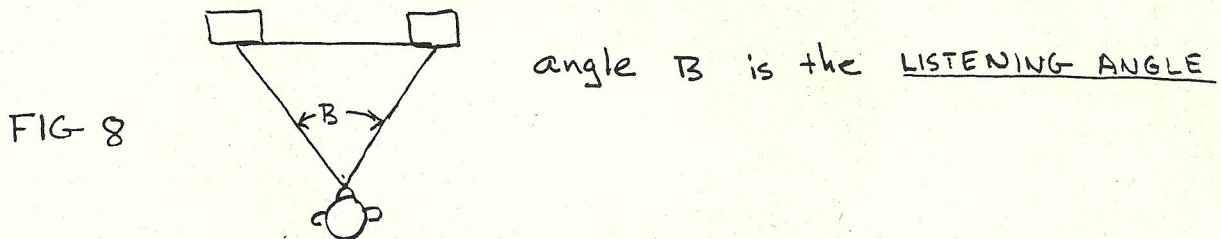
- (A) Holographic Injection Ratio - front panel
- (B) Holographic Listening Angle - back panel

The HOLOGRAPHIC Injection Ratio switch generally is used in the Normal (out) position. This is for most recordings that use "multiple" microphone mixdown techniques. The Theoretical position is used for recordings that have employed the "2 point" or "3 point" method.

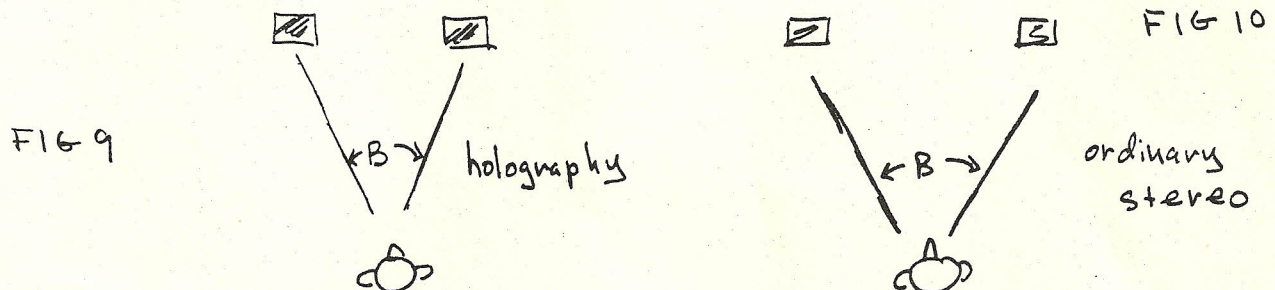
This is not a hard and fast rule, and the choice is not critical. Try both positions after you have listened for a while. The Theoretical (in) position will, in general, yield slightly greater holographic effect.

The Holographic Listening Angle switch is ordinarily used in the Normal position.

The meaning of the Listening Angle is the angle that the listener subtends with the loudspeakers. Refer to Figure 8.



For best holographic performance, the loudspeakers should be somewhat closer together than for ordinary stereo. This is shown in Figure 9 and Figure 10.



The switch should be in Normal if angle B is equal to or less than that formed by an equalateral triangle generated by the loudspeakers and the listener. This is the preferred arrangement.

If it is necessary to sit closer to the loudspeakers for any reason, and angle B is greater than that formed by an equalateral triangle, the switch should be in the wide position.

DEALING WITH PLACEMENT COMPROMISES

It may not be possible to achieve an ideal position with the speakers sufficiently removed from the rear walls. In this case, you may compensate by positioning the speakers close together and listening at a shorter distance corresponding to the distance between the speakers. This arrangement provides for near field reproduction and minimizes the effects of reflections.

If it is not possible to move the speakers away from the side walls, then angle them slightly (and equally) so they are pointing at your ears. Sound absorbant padding will allow the hologram to "think" that it is in a larger, non-reflective area and will yield excellent results in difficult cases.

The speakers must be positioned exactly symmetrical to the listening position. This is necessary to preserve the phase integrity of the Sonic Hologram. Even a difference of several inches of relative speaker location can cause the sonic image to contract or collapse (Figure 4). It is therefore necessary that the visual and acoustic centerlines coincide. The visual centerline is the centerline that the listener would judge by viewing the two speakers. The acoustic centerline (preferred axis) is the centerline that the listener must be on for best holographic imaging. They may not be the same. In our previous discussion, we showed how to find the acoustic centerline. The object of positioning the loudspeakers is to cause the visual

centerline and the acoustic centerlines to coincide. Carefully study Figure 11.

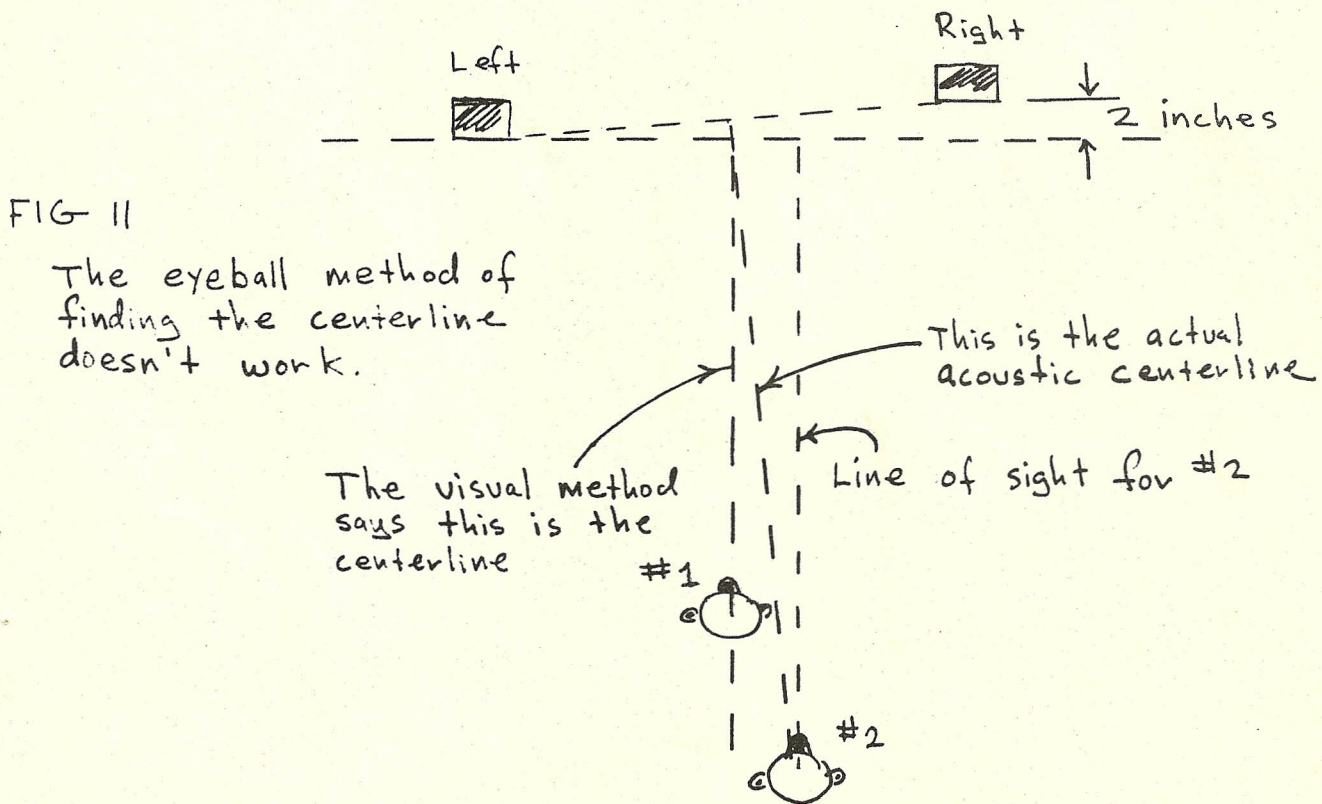


FIG 11

The eyeball method of finding the centerline doesn't work.

The visual method says this is the centerline

This is the actual acoustic centerline

Line of sight for #2

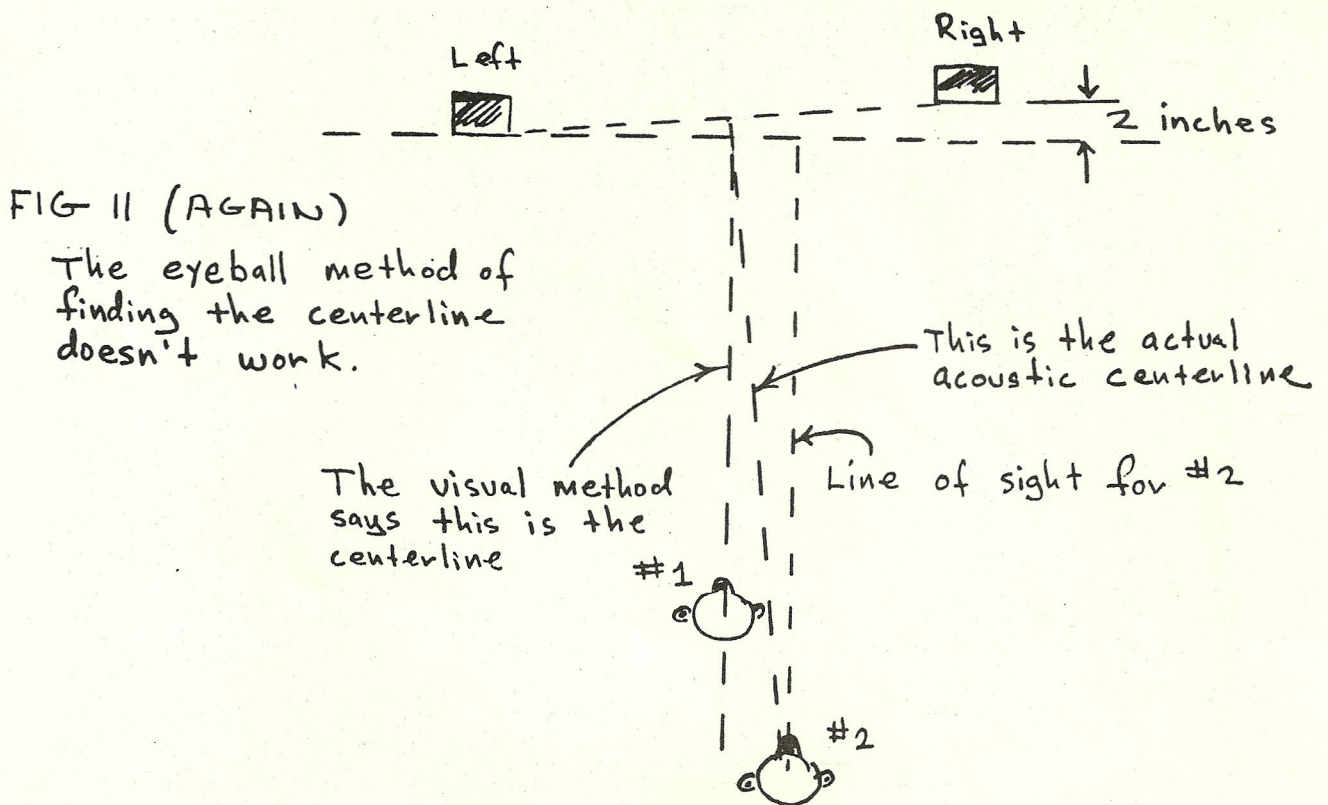


FIG 11 (AGAIN)

The eyeball method of finding the centerline doesn't work.

The visual method says this is the centerline

This is the actual acoustic centerline

Line of sight for #2

The right speaker is set back only two inches relative to the left one; too small to be easily visible. This causes the "real" or acoustic centerline to shift to the right, as shown. Person number two is in the correct listening position, but it will seem to him, visually, that he is too far over to the right.

Person number one will swear (visually) that he is precisely between the speakers, in fact, he is actually too far over to the left side, and the Sonic Hologram will not work properly. If number one shifts over to the right so as to intersect line B, he will be in the optimum position.

Inspecting Figure 11 shows us that if the right speaker were moved forward a mere 2 inches, the acoustic centerline at the listener location would shift more than a foot or so towards the visual centerline. A piece of string is an easy way to cause the visual and acoustic centerlines to coincide; and it will give you the correct listening location.

Put a chair in the preferred listening position. Take a single piece of string length L and have a helper hold it to the center of the chair. (The top or the seat or the back. Just so its the center). Position the two speakers on the radius of the arc formed by the string. Choose an angle somewhat narrower than the normal stereo angle. Figure 12

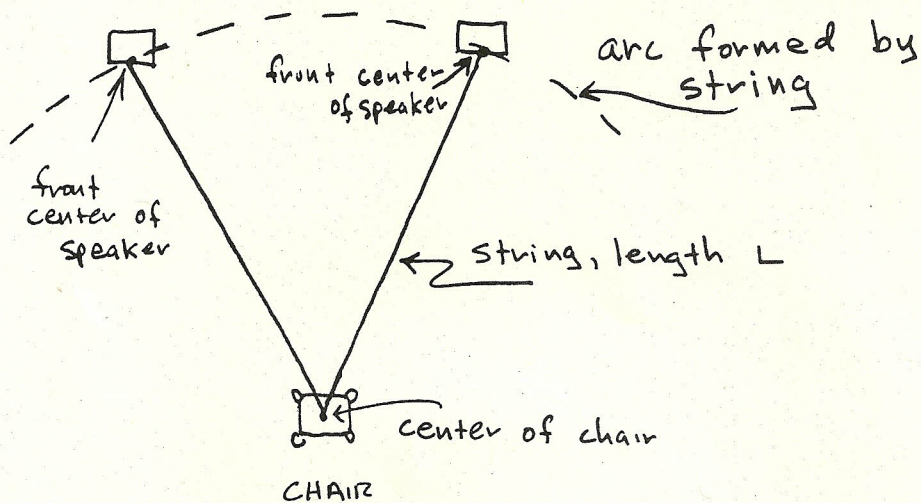
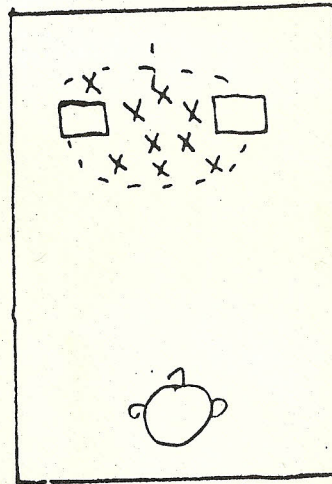


FIG 12

Be careful not to pull on the string too hard or it may stretch. This could result in it not being the same length when positioning the right and left speaker.

Diagrammed below are sound images shown with an X for a properly set up system. Also shown, are a number of systems that are set up but not operating properly for one reason or another. Study the illustrations carefully, for an understanding of these drawings will help you arrange your system for the best possible holographic imaging.

FAULT!

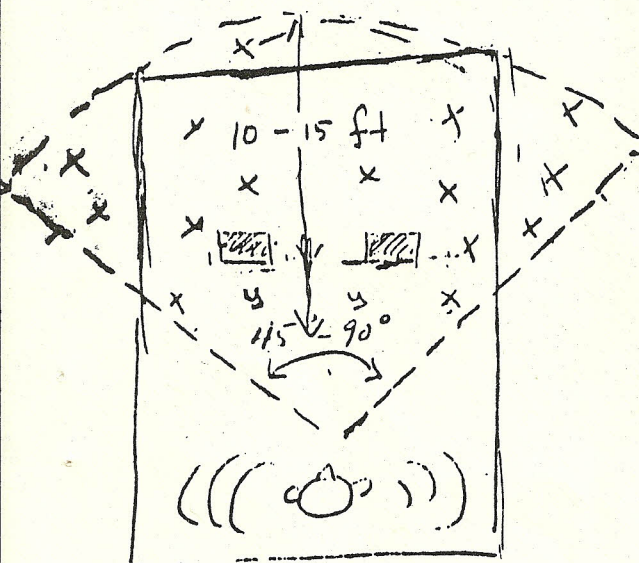


This is the most common fault of all and occurs almost universally when the hologram is switched on for the first time. It is caused by not being on the preferred axis and/or too many reflections

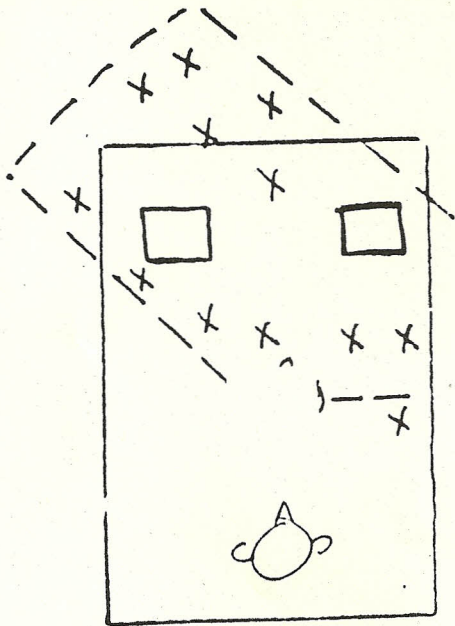
Fault!

Sound images fail to extend beyond the confines of the loudspeakers. Sound image behaves pretty much like ordinary stereo.

PERFECT!



Very common fault. Will almost always occur until system is optimized. Do not worry.



Fault!

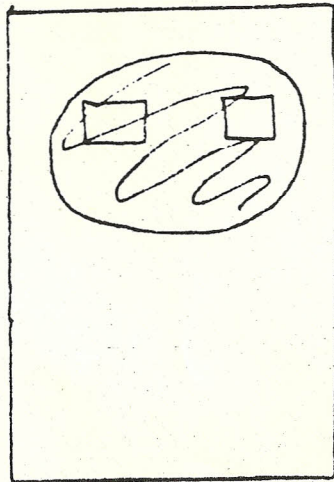
Sound images fail to extend beyond the right wall.

Cause: Large reflective surface on the left, absorbent surface on the right. Or, a larger area on the left side.

Cure: Tow speakers inward: place sound absorbing sheet where images bump into wall: Move speakers away from wall.

Fault!

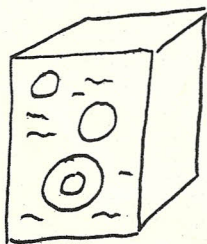
Sound images blurry, fuzzy. Localization difficult. Musical instruments "smeared" over a large space. Imaging fails to take place.



Cause: Extremely early reflections that occur within the first 300 micro seconds; ie., 300 millionths of a second. It is almost always caused by reflections associated with the front panel baffle board of the loudspeaker. It is very easily solved by placing a cutout of 3/4" felt around each of the drivers on the front panel board of your speaker.

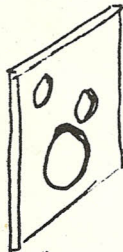
Cure:

large wood front board



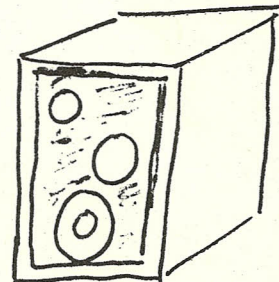
loudspeaker

+



$\frac{1}{2}$ " or $\frac{3}{4}$ " felt acoustic padding

=



loudspeaker with acoustic padding

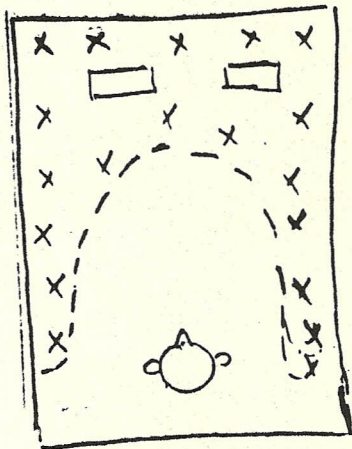


FIG E

This may or may not be considered a fault, depending upon your preference. The sound images have wrapped around the listener 180°, forming a large horseshoe arc of sound. This is a very dramatic sound field and is generally very enjoyable; it is a different sort of image than the classic image.

Refer to figure E.

This sound field occurs under the following conditions.

- A) Loudspeaker with very good imaging qualities (more on this later).
- B) Speakers positioned properly away from the walls.
- C) Room slightly on the "live" side, ie: highly reflective.

The imaging may be changed as follows. In this case, it may be desirable (again, depending on your taste) to actually dilute the holographic effect with some room boundary reflections by moving the loudspeakers closer to the side walls. This will prevent the extreme "wrap" of sound images. Another approach would be to tilt the loudspeakers inward and put the listening position closer to the speakers. Or install sound absorbing acoustic padding.

SUMMARY OF BASIC RULES

- 1) Loudspeakers on stand unless expressly designed for floor standing.
- 2) Area of loudspeakers should be acoustically "dead". ie: no reflections. (Accomplished by speaker-to-wall distance or by sound absorbing padding).
- 3) Area of listener should be "live". ie: a rear wall, one to four feet behind the listener.
- 4) Carefully establish preferred axis and have a way to easily return to it.

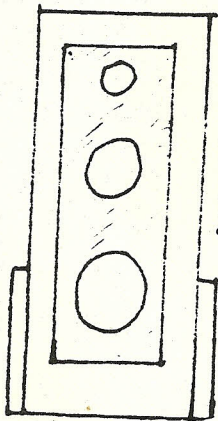
PSYCHOACOUSTICS AND PSYCHOOPTICS AT WORK

We have found that it is extremely difficult to initially "hear" the sound images coming from beyond the boundaries of the listening room. Even when they are. Almost all people will "hear" the sound inside of the listening room at first, and some learning is required to "undo" these impressions. The fast fix is to listen to the system in absolute darkness for about 20 minutes and to mentally "find" each musical instrument floating in space. An

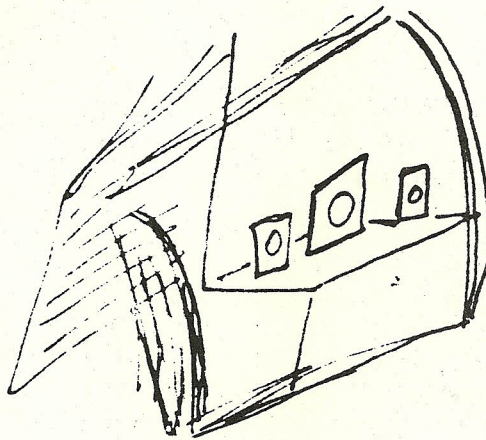
alternative is to close your eyes while listening, although this doesn't work as well as pitch dark.

LOUDSPEAKER DESIGN AND THE SONIC HOLOGRAM

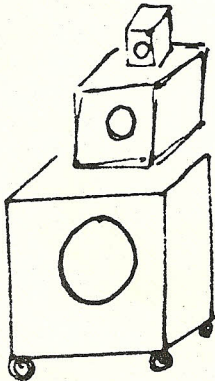
Reflections are the nemesis of the Sonic Hologram. Consequently, loudspeakers that have controlled "standard" dispersion characteristics are, in general, preferred over loudspeakers that have "non-standard" dispersion characteristics. Many loudspeakers have eliminated the early reflections by their design. Some examples are shown below.



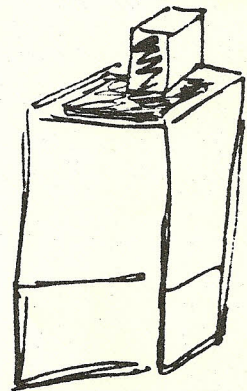
Sound absorbing padding around drivers.



Each driver individually mounted on separate small baffle boards.

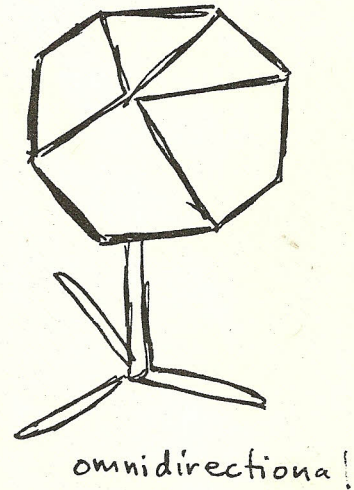
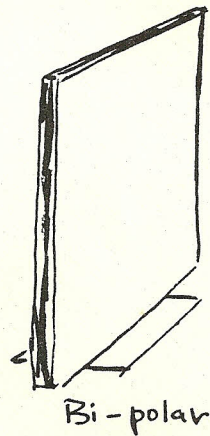
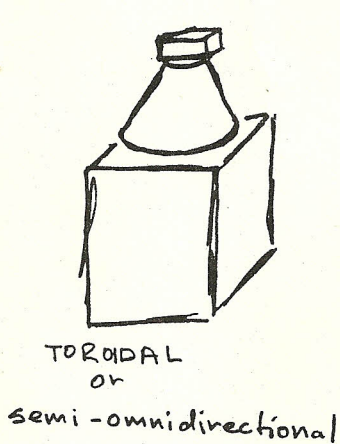


Each driver mounted in a separate small enclosure.



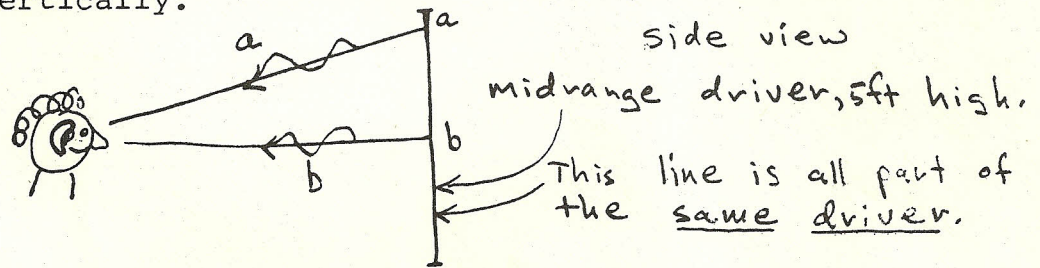
Combination of sound absorbing padding and separate small enclosure.

The loudspeaker should have a smooth, wide dispersion pattern without "scatter". Many loudspeakers have "non-standard" radiation patterns. These loudspeakers may be used only if they are located at least three to four feet from a wall. Some examples are shown below



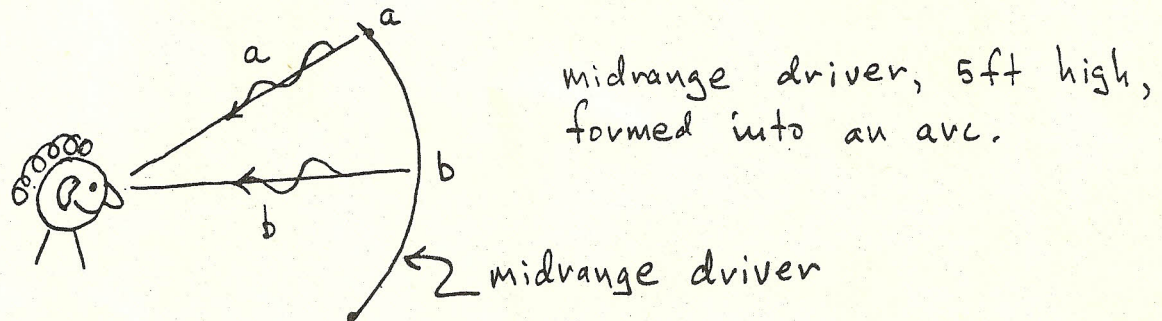
TIMING IS IMPORTANT TO THE SONIC HOLOGRAM

Consider the diagram below of a hypothetical speaker with a midrange driver made out of a "magic" long piece of wire that runs five feet vertically.



Path (a) is longer than path (b) and the sound from (a) will arrive after sound from along (b). Just like a reflection.

The fix



Path (a) = path (b)

The sound arrives correctly timed.

Path (a) = Path (b). The sound arrives correctly timed.

MULTIPLE DRIVER "TIME ALIGNMENT" IS NOT, REPEAT, NOT IMPORTANT TO THE SONIC HOLOGRAM.

As long as each driver can be approximated as a point sound source, the Sonic Hologram will work equally well, regardless the loudspeaker is "time aligned" or not.

IT IS HARD TO PREDICT.

If your speaker does not have visible evidence of design effort to reduce early reflections, this by no means implies trouble. We have found that most speakers with a conventional front panel surface do not have serious reflections, and do indeed work very well with the Sonic Hologram. It is impossible to predict by simply looking at the loudspeaker.

USING IT ALL TOGETHER

After you have mastered the C-4000 Sonic Hologram Generator you will probably not expect that a further improvement is possible. It is now time to turn on the Time Delay and gradually advance its controls as instructed earlier. The sound field created by the Sonic Hologram Generator should now expand and "fill out" slightly. Each instrument will appear where it was when it was recorded--and in the size space in which the recording was made. Turn on the auto-correlator, set the threshold control at about 2 o'clock. Turn on the peak-unlimiter, set its control almost all the way up. The red light should flash on loud peaks. Listen.

We are proud of this achievement and hope these instructions make it possible for you to share in the experience.

NOTE

THE SOUND ABSORBING ACOUSTIC PANELS REFERRED TO IN THIS MANUAL ARE OWENS CORNING (OR EQUIVALENT) DECORATOR SOUND PANELS. COMES IN 2 PASTEL COLORS. MODEL R-10 DECORATOR LINEAR GLASS CLOTH. COMES IN 4'X 8', 2'X3' AND 2'X4' SHEETS.

These panels are so powerful, that if you put your ear against one it will seem as if you have gone deaf in that ear. It will make you want to yawn to "clear" your ear. They are available at builder supply stores.

The purchase of the CARVER C-4000, SONIC HOLOGRAPHYtm Autocorrelation Preamplifier gives an implied license only to use the apparatus to play sound recordings, but not to make sound recordings. For those purchasers who wish to use the C-4000 to make a small number of single recordings for the purchaser's private entertainment and not for a commercial purpose, present policy is to grant a limited license to permit use of this apparatus only for that purpose on a royalty-free basis, with the understanding that such single recordings are not to be copied or sold.

However, the purchaser is warned that making a sound recording from an existing sound recording may be a violation of a third party's copyright. The royalty-free license granted should not be construed as permission to make a copy or a modified copy from any copyrighted work, since permission to do so should be obtained from the copyright holder.

For those who may wish to make sound recordings incorporating the technology of the SONIC HOLOGRAM GENERATORtm on a commercial basis, consideration is presently being given to a licensing program. Contact Robert W. Carver, P.O. Box 664, Woodinville, Washington 98072.

HELPFUL HINTS

1. For best possible signal-to-noise ratio at very low listening levels, the output mute switch should be engaged. This causes the volume control to operate in its most linear range. A good rule is to engage the output mute switch whenever you find the volume control below 8 or 9 o'clock.
2. Present day technology regarding time-delay systems is not as advanced as it is in the best linear circuits, especially in the areas of noise, distortion, and freedom from overload. It may therefore be unrealistic to expect the same level of performance from the time delay system as one would expect from the main system. However, since we "hear" the time delayed signal only subconsciously, the time delay enhancement of stereo or Holography can be completely achieved if the following precautions are observed.
 - a) Don't play the time delay channels so loud that your attention is focused on the rear speakers.
 - b) If you use an external time delay power amplifier, reduce its volume control if noise is a problem.
 - c) Best noise/distortion performance of the time delay will be obtained when the time delay output level is set between 11 o'clock and 5 o'clock.

Be aware of the following. The main pre-amp volume control controls the signal level going into the time delay circuits. The time delay output level controls the signal level into the built-in time delay power amplifier. Some experimentation will quickly allow you to determine under what conditions the built-in 25 watt amplifiers may be driven into clipping with your speakers and/or listening preference or the time delay circuits themselves overloaded. The dynamic range of the system is sufficient to allow full power operation of the built-in amplifiers, with background residual noise that is absolutely inaudible. However, to achieve these results generally requires some experimentation.

3. Time delay loudspeaker impedance.

Each power amplifier built into the C-4000 is rated for 4 ohm and up operation. The optional center front channel output is a derived output channel from the two power amplifiers. **THE COMBINED LOUDSPEAKER IMPEDANCE MUST NOT FALL BELOW 4 OHMS FOR EACH AMPLIFIER OR A TOTAL OF 2 OHMS FOR BOTH.**

Examples: What is the total impedance of three 8 ohm loudspeakers?

Answer: $8 \div 3 = 2.66$ ohms. O.K.

What about three 4 ohm speakers?

Answer: $4 \div 3 = 1.33$ ohms NOT O.K.!

You can only use two 4 ohm speakers because
 $4 \div 2 = 2$ ohms O.K.

What about two 4 ohm speakers and one 8 ohm speaker?

We use the formula for impedance.

Impedance = $(1/4 + 1/4 + 1/8)^{-1} = 1.6$ ohms.

Technically NOT O.K. But it might work, depending on your loudspeaker. It would be worth a try.

What about two 8 ohm speakers and one 4 ohm speaker?

Impedance = $(1/8 + 1/8 + 1/4)^{-1} = 2$ ohms O.K.

4. VOLUME CONTROL

The master volume control in your C-4000 has been designed in such a way that it will not turn all the way off when rotated fully counterclockwise. This feature prevents the normally small tracking errors that commonly result when volume controls are used below approximately 8 o'clock. For extremely low level listening, push the -15 dB switch.

5. UNUSED INPUTS

A small amount of signal leakage may occur on unused (unterminated) inputs. For example, if your tuner is turned on, and you put the selector switch to aux 1, and nothing is plugged into aux 1, you may hear the tuner at a reduced level way down close to the noise floor. However, this will not occur if the input is being used. (It is said to be "terminated".)

If you wish, you may terminate unused inputs (NOT OUTPUTS) with shorting plugs available at Radio Shack or your dealer.