

Model 4000
PREAMPLIFIER

Phase Linear

OWNER'S MANUAL

Model 4000 PREAMPLIFIER

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Phase Linear CORPORATION

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You have purchased the most advanced audio control console available today. Proper use of your Phase Linear 4000 will allow you to reproduce music in a more life-like manner than previously possible with any other preamplifier. We hope you will read this manual thoroughly in order to appreciate the flexibility designed into your Phase Linear 4000.

Recording studios and record processing companies today employ a number of "necessarily evil" techniques dictated by technological limits unavoidable in today's state of the recording art. Taken together, these techniques may be described as processes which serve to limit and restrict the dynamic range of recorded material to an extent that a "manageable" signal is produced. Unfortunately, their use is necessary in order to put the tremendous dynamic range of live music onto the surface of modern phonograph discs and tapes. When used properly, the Phase Linear 4000 will significantly correct these shortcomings inherent in the recording process.

Before leaving our factory your Phase Linear 4000 was tested and certified to be in perfect operating condition. This manual has been prepared to help you operate your Phase Linear as well as keep it in perfect condition. Your Phase Linear, with care befitting all fine instruments, is capable of truly providing a lifetime of musical fulfillment.

**WARNING—TO PREVENT FIRE OR SHOCK HAZ-
ARD DO NOT EXPOSE THIS APPLIANCE TO RAIN
OR MOISTURE**

All warranty service must be performed at a warranty station located in the country where the unit was purchased or at the Phase Linear factory.

If you have any questions concerning the warranty please write to:

**Service Manager, Phase Linear Corporation
20121 48th Avenue West, Lynnwood, Washington 98036**

HOOK-UP INSTRUCTIONS

Please follow these instructions when hooking up your preamplifier:

FOR STEREO USE

1. Check front to insure
 - a. The power switch is in the *off* position.
 - b. The volume control is fully counterclockwise.
 - c. All other switches in *up* position except Power Peak Unlimit, Correlator, and Output Normal Switch. Use -20 dB position unless higher volumes are required by your speaker.
2. Plug in AC cord. Leave preamplifier turned off.
3.
 - a. Connect your turntable into Phono 1 input. Connect the AC from the turntable into the unswitched outlet on the 4000.
 - b. Connect your tuner into the tuner input. Connect your tape deck, second phono, etc. into the appropriate inputs.
 - c. Insure your amplifier is turned off. Connect the preamplifier into the left and right channels of the amplifier using main outputs L and R. Should you be using the 4 channel facilities, hook LR and RR to the amplifier driving your rear speakers. The power amplifier should be plugged into the switched AC outlets marked Amp 1 and Amp 2 on the rear of the preamplifier.
4. Turn-on
 - a. Make sure the volume control on your power amplifier is turned down and the unit is shut off. Place selector switch on the front panel of the preamp to the desired source.
 - b. Turn on your preamplifier and recheck all connections. Wait several seconds before turning on the power switch on the power amplifier if the unit has one.
 - c. Turn on the source material (turntable, tuner, etc.)

- d. When using a power amplifier without a volume control your preamplifier will control the output levels. In this case turn the volume control up until music is heard. Continue to turn up the volume to the desired levels.
- e. When using a power amplifier with level controls, they should be fully advanced under normal listening conditions. Occasionally, extraneous noise may be reduced when operating at extremely low listening levels by retarding the level controls a slight amount.
- f. Experiment with the 4000 at low volume until you understand its operation.
- g. The level settings on all auxiliary equipment should be adjusted for equal volumes as the Selector Switch is rotated.

FOR 4 CHANNEL SYSTEM OPERATION

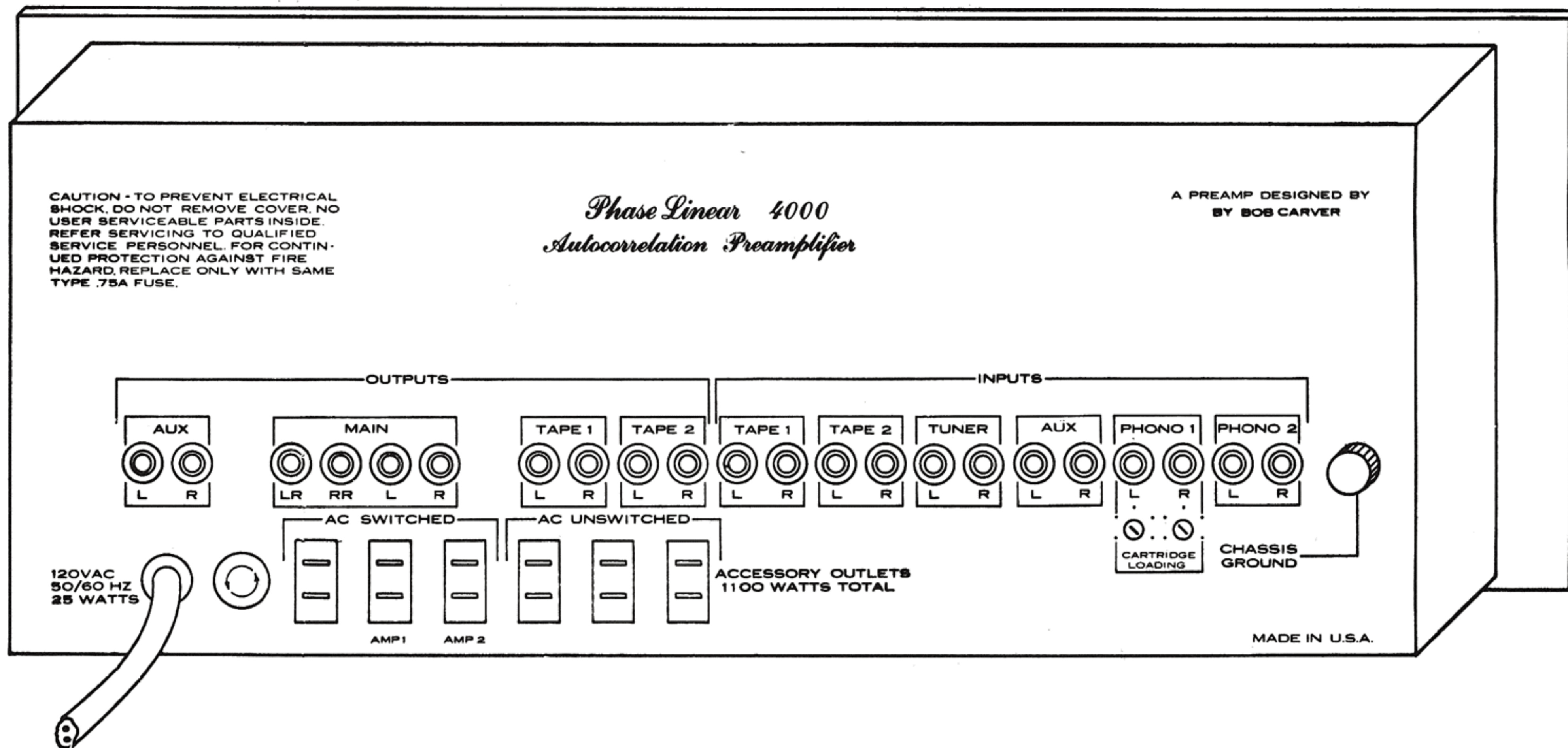
1. Put 4 channel/ 2 channel switch in *up* position.
2. Connect outputs for rear channel up to amplifier.
3. Turn on unit and adjust balance control on the front panel for the desired balance.

AUXILIARY EQUIPMENT HOOK-UP

Equalizers such as the Bose Equalizer should not be inserted into the Tape Monitor path of the 4000. It must be installed between the preamp and the power amp. This rule applies to any accessory equipment that normally would connect in the Tape Monitor path if the unit: (1) Does not have unity gain, and (2) Does not have flat frequency response. A tape recorder, a Dolby processor, or a DBX expander may be used through the Tape Monitor path if desired.

REAR PANEL DISPLAY

Figure 1.



OUTPUTS CONNECTIONS

AUX - High level line output. Signals that appear at the AUX outputs are identical to those appearing at the Main outputs.

Main (LR) (RR) (L) (R) - Preamp output signals (4 channels) which go to power amplifiers. L and R are the front channels.

Tape 1 (L) (R) - Connects to record/line inputs of master tape machine (Tape #1).

Tape 2 (L) (R) - Connects to record line inputs of second tape machine (Tape #2).

AC Switched Outlets - Three outlets allowing remote power amplifiers to be switched by preamp.

AC Unswitched Outlets - Accessory outlets for tape machines, turntables, fans, etc.

INPUTS CONNECTIONS

Tape (L) (R) - From playback/line outputs of master tape machine (Tape #1).

Tape 2 (L) (R) - From playback/line outputs of second tape machine (Tape #2).

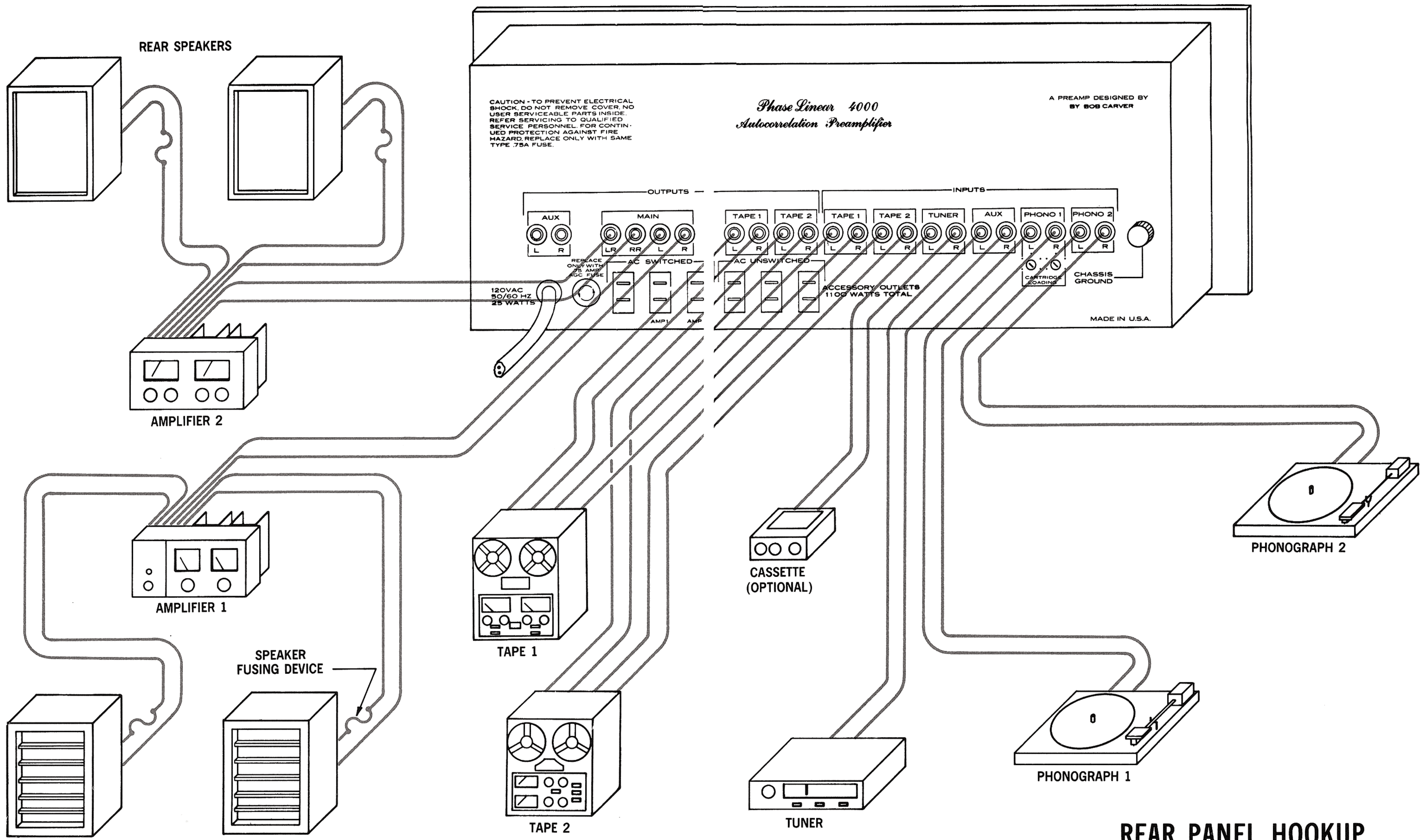
Tuner (L) (R) - From FM/AM tuner.

AUX (L) (R) - From musical instruments, TV, etc.

Phono Plugs - Phono plugs with extra long center connectors may not work properly with the Phase Linear 4000 unless the following precaution is observed: Squeeze the outer connector slightly with pliers and insert into the preamp jacks $\frac{2}{3}$ of the way. These nonstandard "RCA type" phono plugs appear on European equipment.

Cartridge Loading - Used to adjust Phono 1 for proper resistance loading (damping) of magnetic cartridges.

Chassis Ground - Used for ground return wire of turntables, etc.



REAR PANEL HOOKUP

Figure 2.

SELECTOR SWITCH - Determines source to be played through preamp.

PHONO 1 - The main phono input. This is equalized to the standard record equalization curve (RIAA) for magnetic cartridges.

PHONO 2 - This input may be used for an auxiliary phonograph. Its equalization is identical to Phono 1. AB comparisons of cartridges may be made using Phono 1 and Phono 2.

TUNER - This input is used for the playback of a FM/AM tuner.

AUX - This input may be used for playback of various accessories such as musical instruments, second tuner, microphone, T.V., etc.

TAPE - This input is intended for playback of a second tape machine. Playback of the master tape machine (Tape #1) is achieved by depressing the tape monitor switch.

UNLIMIT THRESHOLD - Rotate clockwise to increase dynamic range of program material. Adjust so that unlimit indicator lamp illuminates on musical peaks and extinguishes between musical peaks. This simultaneously adjusts both peak unlimiter and downward expander.

UNLIMIT INDICATOR LAMP - Provides visual indication of peak unlimit operation. This indicator will remain operational in either position of peak unlimit switch.

TAPE COPY - In the copy position (*up*) a second tape machine (Tape #2) output may be recorded directly onto the master (Tape #1) tape machine. The user may listen to any source chosen by the Selector Switch while the copy is being made. When depressed, recordings from any source chosen by the Selector Switch may be made onto either tape machine.

TAPE MONITOR - In source position (*up*) the preamp will play any source chosen by the Selector Switch. In the *down* position the preamp will monitor the playback output of the master (Tape #1) tape machine. This is the standard tape monitor function.

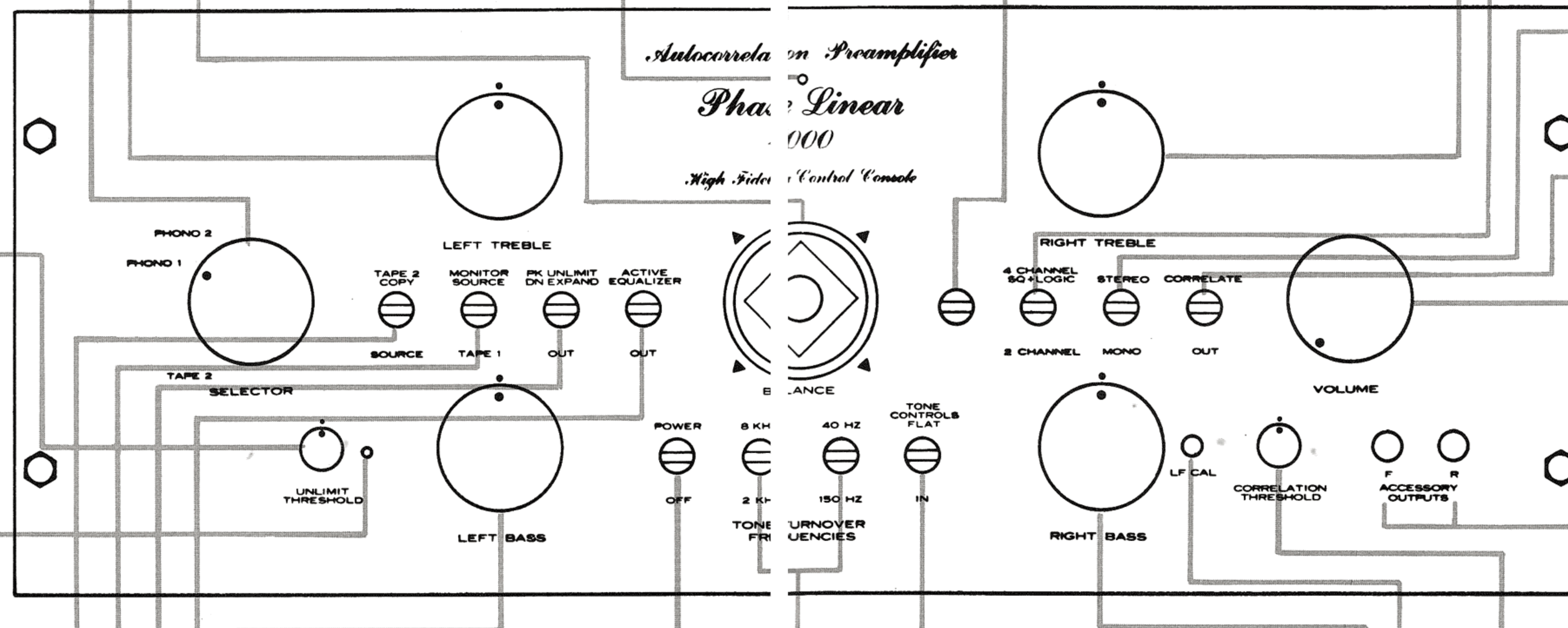
PEAK UNLIMIT - Up position activates both peak unlimiting and downward expand circuits. Depress position by-passes these circuits.

ACTIVE EQUALIZER - Provides low frequency equalization to extend and flatten low frequency response of speaker system.

LEFT TREBLE - Use to boost or cut high frequency response according to taste and listening conditions. To boost, rotate clockwise. To cut, rotate counter-clockwise. The left treble control simultaneously operates both front and rear channels.

JOYSTICK BALANCE CONTROL - Upward motion shifts sound image towards front; downward motion shifts sound image towards rear. Right and left motion shifts sound image to the right or left.

POWER INDICATOR - Illuminates when power is applied.



POWER SWITCH - Main 'on-off' switch. This switch simultaneously activates preamp and control relay which applies power to auxiliary equipment plugged into switched outlets on the rear panel.

TONE TURNOVER FREQUENCIES
High - This switch is used in conjunction with the tone controls. It controls the high frequency point at which the treble controls begin to take effect. Elevating this switch causes the treble controls to affect frequencies above 8 KHz. Depressing it causes the treble controls to affect frequencies below 2 KHz.
Low - Controls the low frequency point at which the bass controls begin to take effect. Elevating this switch causes the bass controls to affect frequencies below 40 Hz. Depressing it causes the bass controls to affect frequencies below 150 Hz.

TONE DEFEAT - Depressing activates tone control circuits and allows use of bass, treble, and turnover controls. Raising switch restores flat frequency response regardless of tone control positions. Up position by-passes all tone control networks.

RIGHT BASS - Use to boost or cut low frequency response according to taste and listening conditions in right channels. To boost, rotate clockwise. To cut, rotate counterclockwise. The right bass control simultaneously operates both front and rear channels.

LEFT BASS - Use in the same way as right bass. Operates left channels.

OUTPUT NORMAL - In the Normal Output (*up*) position, the preamp operates in a full and normal gain configuration. In the -20 dB position, the output is muted approximately -20 dB. The volume control is arranged in such a manner that extremely low level listening must be accomplished by depressing the Normal Output switch to -20 dB, then using the volume control in the normal fashion. As a general rule, the Volume Control should be operated at or above the 10 o'clock position in the "normal" setting. For lower volume settings, you should switch to the "-20 dB" position and adjust the volume to the desired level. This arrangement allows a finer and more precise adjustment at very low levels than would ordinarily be possible.

RIGHT TREBLE - Use in the same way as left treble control. Operates right channels.

4 CHANNEL/ 2 CHANNEL SELECT - Depressing this switch disables the rear channel outputs and may be used to mute the rear speakers. Use the 2 channel position if you have a 2 channel system. Use the 4 channel position if you have a 4 channel system. With a 4 channel system, enhanced 2 channel performance is obtained by using the 4 channel position.

STEREO-MONO - Depressing this switch combines all four channels and should be used when playing a monophonic source. The stereo position should be used for 2 channel or 4 channel source material.

CORRELATE SWITCH - Depressing this switch by-passes the autocorrelator noise reduction system. Elevating it causes the signal to be routed through the autocorrelator to reduce noise.

VOLUME CONTROL - Rotate clockwise for increase in signal level. Switch to -20 dB position when volume control is below 10 o'clock position. This arrangement allows a finer adjustment at low levels.

ACCESSORY OUTPUTS - Main outputs to be used for headphones, tape recorder, second amplifier, or to provide an output signal that has been processed by the noise reduction system for tape recording. Each jack contains both left and right channel signals. The "F" jack carries front channel signals and the "R" jack carries rear channel signals. 2 channel stereo headphones connect to the "F" jack, 4 channel stereo headphones to both "F" and "R" jacks.

CORRELATION THRESHOLD ADJUSTMENT - Rotate counter-clockwise to remove noise from program material. Correct adjustment is indicated by absence of random hiss and presence of all high frequencies associated with the musical program. Incorrect adjustment is indicated by complete loss of high frequencies or by presence of noise in the program. Typically, proper settings are found in the eleven to three o'clock positions though this setting will vary with the source material.

LOW FREQUENCY CALIBRATION - Adjusts low frequency noise reduction. Refer to *correlator* section of manual for adjustment procedure. This control requires adjustment only upon initial installation.

FRONT PANEL SWITCHES AND KNOBS

Figure 3.

OPERATING INSTRUCTIONS

The first step in operating your 4000 should be to verify that the phonograph section works properly. Set the front panel switches as outlined in Figure 3. After this has been completed and your system is performing properly, you may wish to experiment with the autocorrelator in order to gain familiarity with its operation.

AUTOCORRELATOR

The AUTOCORRELATOR is a *noise reduction system* designed to remove noise from the signal source. The following steps should be used to adjust the AUTOCORRELATOR:

Step 1:

Rotate the CORRELATION THRESHOLD control fully clockwise.

Step 2:

Check to insure that the Correlate Switch is in the "up" position.

Step 3:

Put on a good quality record, advance the treble controls to full maximum and activate the 2 kHz Turnover Switch and Tone Control Switch by depressing downward on both. Select a portion of the record in which hiss may readily be heard against the musical program. Slowly rotate the Correlation Threshold counterclockwise. As the control is progressively rotated counterclockwise, a point will be reached at which the record hiss drops to a very reduced level while the high frequencies of the musical program remain unaffected. Further counterclockwise rotation will have no effect on the program until a rather extreme counterclockwise rotation results in an abrupt and complete loss of high frequencies associated with the music. The Correlator is said to be "in lock" when the threshold control is set anywhere within the two limits outlined above. Too far clockwise will cause the Correlator to fall out of lock and noise will be heard, and too far counterclockwise will again cause the correlator to fall out of lock with the result being a complete loss of highs. The correct setting is midway between these two limits. This setting is rather broad and not at all critical. The action is very similar to the familiar "vertical-hold" control on your television set. Too far in one direction will cause the picture to "roll" down. As with the vertical hold control on your television set, a CORRELATOR THRESHOLD setting too close to either extreme may cause the Correlator lock-in ability to become impaired and it may occasionally and briefly fall out of lock. This is caused by random disturbances on the record surface. The symptoms of this condition are:

1. If the control is improperly set too close to the clockwise limit, the correlator may momentarily fall out of lock and a brief noise pulse or burst will be heard against the music.

2. If it is set too close to the counterclockwise limit, a momentary loss of highs will occur.

In general, a split second loss of highs is never noticeable, but even the briefest noise pulse is highly audible and extremely objectionable. This fact suggests that if you should have a record that seems to cause the Correlator to occasionally fall out of lock, the CORRELATION THRESHOLD should be set somewhat to the left (counterclockwise) of the theoretically optimum position. This will absolutely insure that an objectionable noise burst never occurs.

After some experience has been gained in the operation of the AUTOCORRELATOR, the treble controls may be returned to the settings normally used.

THE DOLBY NOISE REDUCTION SYSTEM AND THE AUTOCORRELATOR

The Autocorrelator differs from the Dolby system in that it is a *single pass* or *open ended* system which *removes* noise from the source without the necessity of the source material undergoing special encoding. The Dolby system is a *noise preventing* system designed to prevent *additional* noise from adding to the signal during tape recording. The Dolby system is a *two pass* or *closed system* which cannot remove noise once it has contaminated the signal, but prevents it from increasing during the tape recording process. Both systems provide approximately 10 dB of signal to noise improvement.

It is possible to obtain a full 20 dB increase in signal to noise by operating the Dolby system in tandem with the AUTOCORRELATOR. A tape recording that has been "Dolbyized" during recording may be "de-Dolbyized" by a Dolby decoder, then processed through the 4000 using the AUTOCORRELATOR.

An interesting psychological phenomenon occurs when high frequency hiss is removed from the program source. It often seems that the absence of hiss is accompanied by a loss of high frequency program material, when in fact, no loss has occurred. At first, with certain kinds of music, the psychological suggestion that high frequency material has been removed along with the hiss is very difficult to overcome. With other kinds of music, it is very obvious that only hiss has been removed. However, after a brief exposure to noise-free music, this psychological phenomenon seems to vanish as one becomes accustomed to a noise free background. Once "acclimated" to a noise free background, it becomes rather unbearable to listen to hiss-contaminated music.

Historically, it took several years before Ray Dolby was able to convince the world his system was able to reduce noise without affecting the high frequencies. This situation was caused by the aforementioned psychological effects.

L F CAL (Low frequency calibration) ADJUSTMENT

L F Cal adjustment is an adjustment that is performed upon initial installation. Before leaving the factory, this control was set to accommodate most systems. Adjustment procedure is as follows:

1. Depress both BASS TURNOVER and TONE CONTROL switches. Raise ACTIVE EQUALIZER and CORRELATE switches.
2. Insert a small blade screwdriver into the L F Cal adjustment hole and rotate the control fully clockwise.
3. Turn down the main volume control.
4. Put the phono stylus pickup on the blank portion of a lead groove on a good quality record. Advance the main volume control until rumble and/or hum is heard in the speakers.
5. Carefully rotate the L F Cal control counterclockwise until an abrupt drop in rumble and/or hum occurs. Rotate the L F Cal control slightly further counterclockwise past the drop-out point. (Approximately 1/16 turn)

This completes L F Cal adjustment and will require readjustment only if the pickup cartridge is replaced with a unit whose sensitivity varies significantly from the first.

ACCESSORY OUTPUTS

These outputs enable a degree of flexibility not provided with most preamps. Basically, they provide an output signal that has been processed by the many features of the 4000. The uses of these outputs are many.

1. They may be used to drive high impedance headphones of the open air variety. Low impedance headphones will have very little volume when driven by the Accessory Outputs and, therefore, should be connected to the power amplifier.
2. The outputs may be used to tape record music which has been processed by the noise reduction system and the tone controls. This feature will be found highly desirable by tape enthusiasts.
3. The outputs may also be used for scopes or an additional power amplifier. A person wishing to drive a second complete system in an adjoining room will find these outputs invaluable.

TONE TURNOVER FREQUENCIES

A significant portion of the cost of the 4000 went into producing a tone control system designed to eliminate the usual "shelf" which exists in the frequency response of most tone controls. In order to fully appreciate the 4000, the Tone Turnover Switches and tone controls should be experimented with extensively and not simply set and forgotten. In doing this, the full value of the 4000 will be utilized.

Independent step tone controls are provided for contouring the extremes of the audio range in order to coordinate the musical program with the listening environment. The turnover points may be separately selected for the bass and treble controls. (The turnover point is the place on the frequency spectrum above and below which the tone control will have an effect.) On the 4000, the turnover point for the bass controls may be set at either 40 Hz or 150 Hz while the turnover point for the treble controls may be set at 2 kHz or 8 kHz. The result of these controls differ from conventional tone controls in that they operate only on the extremes of the audio band at all positions, even in the full boost or cut

mode. They are professional, completely passive, and their boost/cut characteristics are such that the usual "shelf" is eliminated. This allows generous amounts of bass boost to be used without introducing an undesirable boom. The lows simply become more solid and dramatic. Similarly, significant high frequency boost may be utilized without introducing shrillness. The added highs simply augment the musical definition.

PEAK UNLIMITER AND DOWNWARD EXPANDER

The peak unlimiter, together with the downward expander, combine to form a *dynamic range expansion system*. This system is designed to restore a portion of the dynamic range of live music that is normally lost during the recording process. Before discussing the operation of the system, consider the following definition of terms. *Compression* is the function of intentionally altering the musical signal level in such a manner that loud musical passages are recorded more softly, and soft musical passages more loudly than the live counterpart. *Peak compression* refers to the compression operation being performed exclusively on brief musical peaks and is generally referred to as *peak limiting*. *Low level compression* refers to the compression operation performed on very low level signals and normally compresses the average signal level. This operation is generally referred to as *low level gain riding* or *upward compression*.

During the making of a phonograph record, compression is performed by the combination of an electronic compressor together with the skillful application of manual level changes by the recording engineer. (Gain riding).

During very high level musical transients, a device called a *compression-limiter* or *peak-limiter* is employed at the recording studio to compress and limit the level of musical peaks. This is necessary to prevent a system overload associated with the mastering of the phonograph record.

During very quiet, low level passages, the recording engineer manually raises the overall recording gain in order to produce a recording that will be loud enough to cause the background noise level to be acceptable.

The *peak-unlimiter* is designed to restore to a significant extent the musical peaks that are removed by the peak-limiter during recording. (See scope photos) The amount of *peak-unlimiter* operation is a function of the time rate of change, the duration, and the instantaneous level of the input signal (the recording). Tracking is designed to closely compliment the dynamics of recording studio peak-limiters. The maximum amount of unlimit action is + 4 dB, and the maximum attack rate is .5 dB/micro second.

The *downward expander* is designed to significantly restore the lost dynamics that occur due to low level gain riding or upward compression during recording. The tracking of the *downward expander* is designed to closely approximate the dynamics of human gain riding. The rate and the amount of both attack and decay vary independently of each other and as a function of the recording engineers' application of gain riding.

During moderate passages on the record, that is, during passages that are neither very soft nor very loud, both the *peak-unlimiter* and the *downward expander* become inoperative in response to the fact that neither peak compression nor gain riding were employed during that time. It is this feature, together with the ability of the system to expand selectively, that allows it to perform the task of enhancing the dynamic range of recorded material.

CARTRIDGE LOADING

On the rear panel of the 4000 are located two adjustments immediately below the phone input connections. These controls are designed to allow optimum interfacing of the cartridge with the feedback network of the RIAA amplifier.

The cartridge loading adjustment affects both the damping and frequency response of the cartridge. Clockwise adjustment increases extreme high frequency response and a counterclockwise adjustment decreases this response.

The acoustics of your listening room play a major role in the audible results of this adjustment. If you find that the suggested loading position is sonically unsatisfactory you should increase or decrease the response to your taste as described above. If your cartridge is not listed below, you should hook up your system and experiment with various settings (as described above) until a satisfactory response is achieved.

Using a small blade screwdriver, and locate the adjustment slot. Full counterclockwise is the "8 o'clock" position, full clockwise is the "5 o'clock" position. Refer to the following table for the position optimum for your cartridge.

ADC: 990XE - 10 o'clock, XLM - 5 o'clock, VLM - 5 o'clock; **AUDIO TECHNICA:** AT155 - 3 o'clock; **B&O:** SP 10 - 4 o'clock, SP 12 - 4 o'clock, SP 14 - 4 o'clock; **DECCA:** All models - Adjustment to personal taste. We recommend the 5 o'clock position; **ELAC:** STS-44-E - 12 o'clock; **EMPIRE:** 1000 ZE/X - 5 o'clock, 999 TE/X - 5 o'clock, 999 E/X - 5 o'clock; **GRADO:** All models - 12 o'clock; **IMF:** 850 - 10 o'clock; **ORTOFON:** All models - 2 o'clock except M15E - 9 o'clock; **PICKERING:** XV-15/750E - 5 o'clock, XV-15/1200E - 5 o'clock; **SHURE:** V 15 II - 5 o'clock, V 15 III - 11 o'clock; **STANTON:** 500 EE - 12 o'clock, 681 EE - 5 o'clock, 881 SE - 5 o'clock.

SPEAKER FUSING

Phase Linear recommends fusing all speakers for maximum protection. Consult the speaker manufacturer for the proper fuse and install it in the speaker line as shown in Figure 2. One should exercise care in operating the Phase Linear 4000 due to the outstanding performance at all levels. Due to the increased dynamic range and excellent signal to noise ratio, one will tend to play music at very high levels. This should cause no problems as long as the speakers are fused.

ACTIVE EQUALIZER

A built-in active equalizer may be switched in to boost the extreme lows (below 50 Hz). This is done because the vast majority of loudspeaker systems, even rather expensive systems, exhibit a gradual roll-off below 50 Hz. The boost is designed to produce a flatter, more uniform total system response and is particularly useful when used together with powerful amplifiers and speaker systems exhibiting high power handling capacity.

4 CHANNEL/2 CHANNEL

The Phase Linear 4000 is a stereo preamp with 4 channel SQ capabilities. In order to utilize the 4 channel mode of the 4000, one needs two power amps and four speakers. Set the system up as shown in Figure 2. The source should be an SQ record or any other SQ media. One may also use the 4 channel arrangement for enhanced 2 channel performance and we recommend that all 2 channel recordings be reproduced using the 4 channel mode.

TAPE FUNCTIONS

The tape functions of the 4000 have been designed for maximum flexibility in high fidelity systems using either 1 or 2 tape machines. For a single tape machine installation the *Tape 1* inputs and outputs of the 4000 are connected to the transport Line in/out jacks, as shown in Figure 2. The *Monitor Source/Tape* Switch now functions as a standard tape monitor; i.e. when in the up position, *Source*, the 4000 will monitor whatever source is chosen by the *Selector* Switch and simultaneously present it to the tape machine for recording if desired. When in the down *Tape 1* position, the 4000 will playback signals which have been recorded on the tapes. If it is desired to have these signals also present at the 4000's *Selector Switch* *Tape 2* position, the *Tape 2* outputs on the rear of the preamp may be patched to *Tape 2* inputs.

For installation utilizing two tape machines, the main (Master) tape machine's outputs are connected to the 4000's *Tape 1* inputs, and the second (Slave) tape machine's outputs to *Tape 2* inputs. The *Tape 1* and *Tape 2* outputs are then connected to the respective line inputs of the two machines. With the *Tape Copy* Switch in the up position, the *Tape 2* machine's output may be copied directly onto the master (*Tape 1*). The user may listen to any other source as chosen by the *Selector* while the copy is in progress and may at any time check the copy quality by depressing the *Monitor* Switch.

When the *Tape Copy* Switch is depressed, recording from any source chosen by the *Selector* Switch may be made onto either tape machine. Additionally, A/B comparisons of the tape machines may be made by positioning the *Selector* Switch to *Tape 2* and raising and lowering the *Monitor* *Source* Switch.

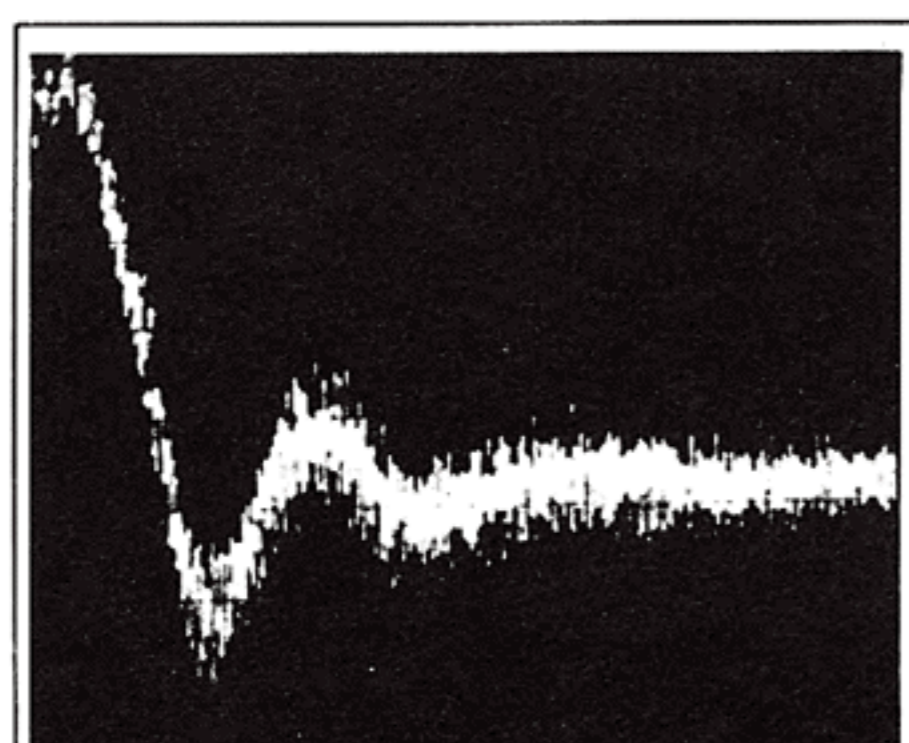


Photo 1.
Output of recording microphone, combined snares and drum of live recording.

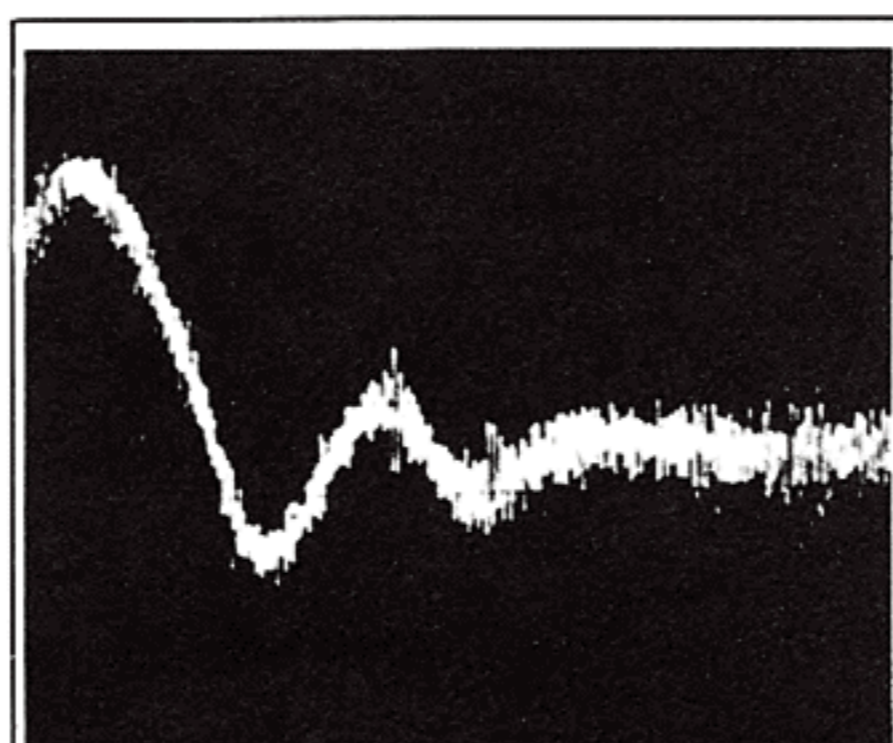


Photo 2.
The musical information of Photo 1, after being compressed, taped, mastered onto a record surface, and reproduced with a modern phono cartridge. Note diminution of the snares at the peak of the high level drum beat. Note also the compression and loss of attack time associated with the drum beat.

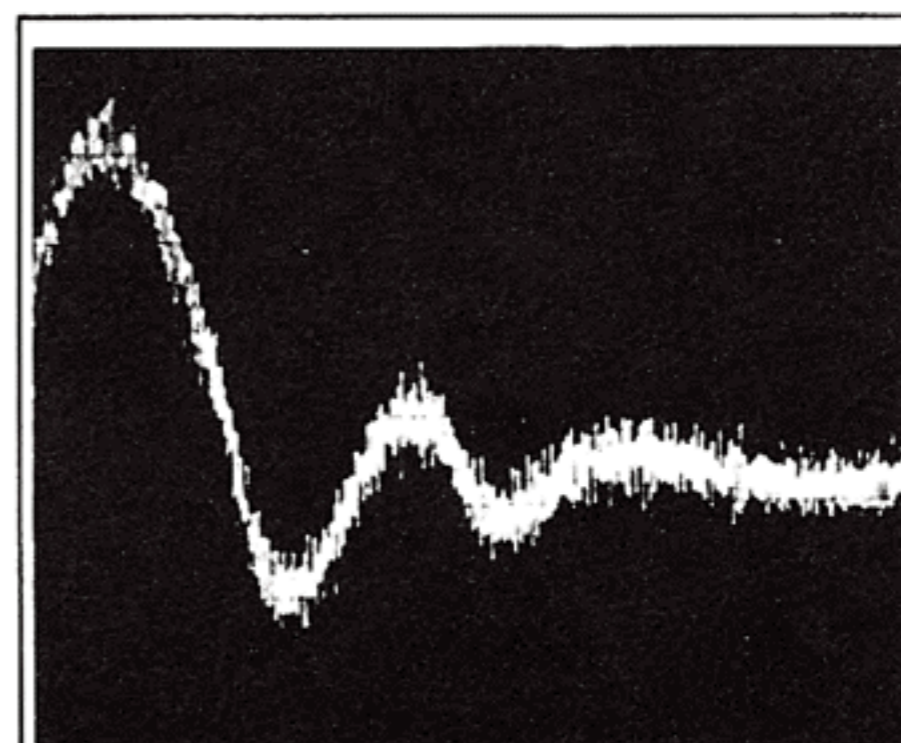


Photo 3.
The music of Photo 2 after processing by the Peak Unlimiter. Note that the fast attack, high level characteristics have been largely restored, and that direct comparison with Photo 1 is possible.

COMMON ADJUSTMENT PROBLEMS

PROBLEM	PROBABLE CAUSE	REMEDY
High noise or hum	-Poor connection in wiring -Power amplifier on full power	Check all wiring Adjust amplifier
High noise, hum or squeal in phono 1 or phono 2	-All above remedies -Turntable not properly grounded -Turntable not wired properly -High local RF radiation from local broadcasting stations	Ground Check wiring Keep leads short
One channel dead	-Poor connection -Balance control improperly set -Front panel adjustments incorrect	Check wiring Adjust Read hook-up procedures
All channels dead	-Tape monitor engaged -Amplifier inoperative -Improper hookup -Source not operative -Selector switch set incorrectly	Adjust switch Check amplifier fuses Check Check tuner, turntable or tape deck Reset switch
Correlator not functioning properly	-Not adjusted for turntable and cartridge	Adjust LF Cal, adjust threshold control
Distortion	-Amplifier fuses blown -Phono tone arm vibrating	Replace fuses Place in location where there is no vibration. Separate from amplifier and speakers.
Peak unlimit/Downward expand not operative	-Improper threshold adjustment	Rotate threshold control fully clockwise
Loss of high frequencies	-Autocorrelator switched in and not adjusted properly.	Adjust
Loss of low frequencies	-Autocorrelator switched in and not adjusted properly.	Adjust
Excessive hiss	Efficient speaker-power amplifier combination	Depress -20 dB switch

If careful troubleshooting as outlined above does not correct the problem, it is possible that one or more of the circuit boards has worked loose in shipment. Disconnect all hookup cables, grasp the unit firmly with both hands, and while listening for rattles, shake it. If a rattle is heard, remove the top cover and replace the loose circuit board by firmly pressing it down into its socket until it is properly seated and all connecting pins are properly aligned.

MAINTENANCE AND SERVICING

CLEANING

To keep your preamplifier clean and looking like new, occasionally clean the front panel with a soft paper towel and full strength ammonia. This will remove dulling films which have a tendency to build up on the brushed finish.

CAUTION: Never remove the front panel by turning the bolts on the face of your preamplifier. This will scar the front panel. To remove the front panel loosen the nuts on the rear of the unit. We do not recommend any person other than a qualified technician authorized by Phase Linear to remove the front panel. This could invalidate the unit's warranty.

REPAIR FACILITIES

Only qualified technicians should be allowed to repair your Phase Linear 4000. The Phase Linear Corporation and its authorized warranty stations have the personnel and equipment to repair your unit. Should you have any trouble with your unit write to the factory for the address of the nearest repair facility. Please include the model and serial number of the unit together with a description of the problem.

SHIPPING

Never ship your Phase Linear in any shipping carton other than the original or a replacement supplied by Phase Linear. For a replacement write to the factory or see your local dealer. If the preamplifier is shipped in other than a Phase Linear carton which is properly packed, all damages must be paid for by the store or person shipping the unit. Ship only via a reputable carrier. **DO NOT USE PARCEL POST!** Insure the unit for the full value and double check to ensure the unit is properly packed.

TYPICAL RESPONSE GRAPHS

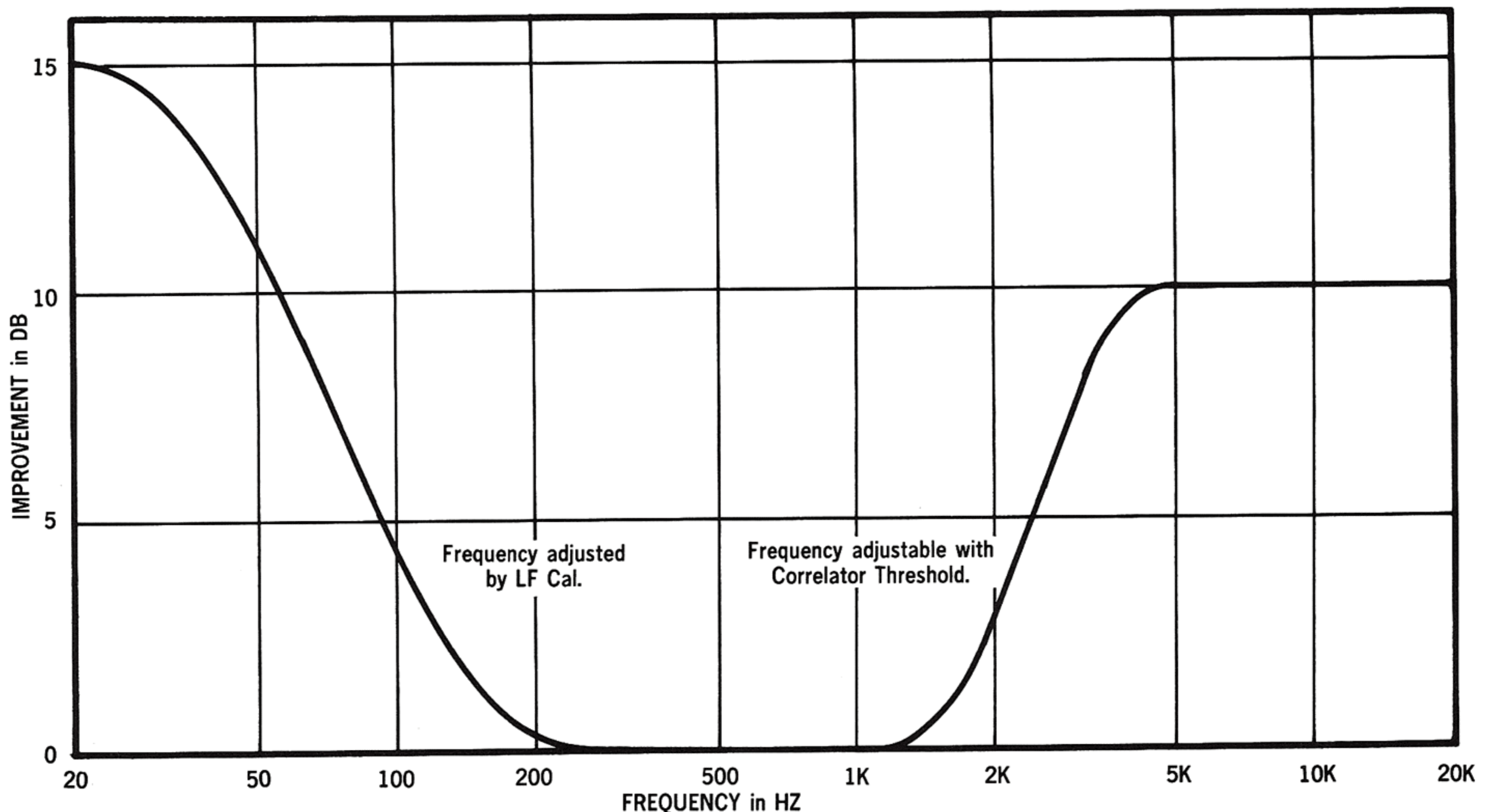


Figure 1. Signal to Noise Ratio Improvement with Correlator

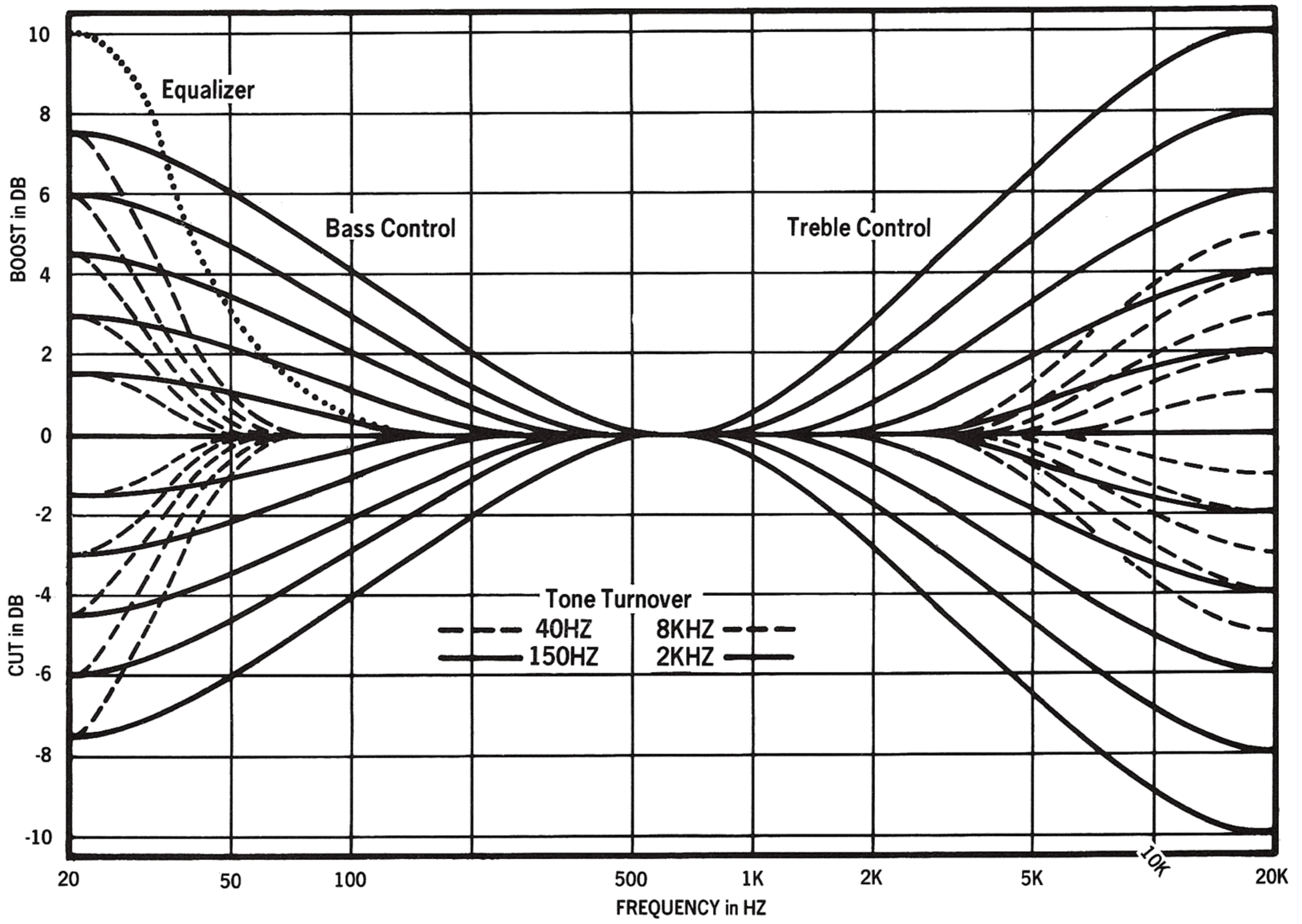


Figure 2. Tone Controls & Equalizer

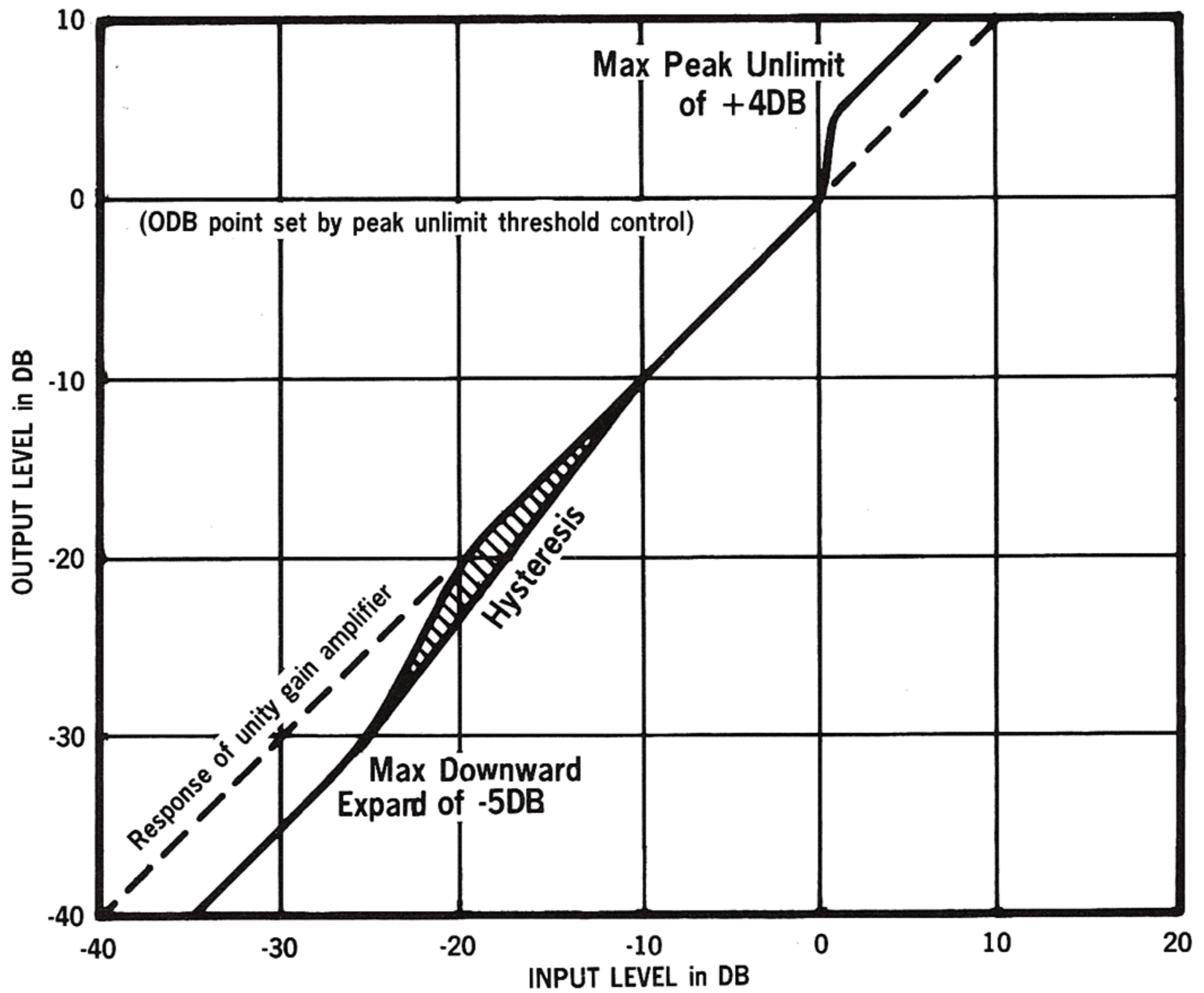


Figure 3. Peak Unlimit & Downward Expand Response

SPECIFICATIONS

TOTAL DISTORTION: Less than .25%.
Typically .02%.

TOTAL NOISE: High Level: 83 dB below 2 volts.
Phono: 72 dB below a 10 millivolt reference.

INPUT IMPEDANCE: Phono: No less than
47k from 20 Hz to 20 kHz. High Level: 50k.

GAIN: Phono: 65 dB. High Level: 15 dB.

OUTPUT VOLTAGE: Full output 8 volts
R.M.S. Better than 2 volts into 4.7k or greater.

FREQUENCY RESPONSE: Phono: Within \pm
1 dB of RIAA from 20 Hz to 20 kHz. High
Level: Within \pm 1 dB from 20 Hz to 20 kHz.

TONE CONTROLS: Bass: Monotonically in-
creasing and decreasing, dual hinge points, \pm 8
dB at 20 Hz. Hinge points switch selectable
beginning at 40 Hz or 150 Hz. Treble:
Monotonically increasing and decreasing, dual
hinge points, \pm 8 dB @ 20 kHz. Hinge points
switch selectable beginning at 2 kHz and 8 kHz.

ACTIVE EQUALIZER: 6 dB/octave boost
below 50 Hz.

PEAK UNLIMITER: (Nominal peak unlimit
rate attack threshold, front panel variable) .5
dB/micro second for + 6 dB. peak unlimit
operation.

**NOMINAL AMPLITUDE ATTACK
THRESHOLD:** .2 volts peak at input to peak
unlimiter.

DOWNWARD EXPANDER: Downward ex-
pansion commences at — 35 dB. Ultimate limit
is — 41 dB. Unlimiter window is 35 dB wide,
upper and lower thresholds are simultaneously
variable by front panel unlimit threshold con-
trol.

FOUR CHANNEL FACILITIES: Built in
CBS SQ system with Phase Linear developed
differential logic for enhanced four channel
separation.

SEMICONDUCTOR COMPLEMENT: 45
transistors, 9 integrated circuits, 57 diodes, 2
zener regulators, 2 light emitting diodes.

**AUTO CORRELATOR (NOISE
REDUCTION SYSTEMS):** High frequency
noise reduction commences at 2 kHz and is 3
dB, reaching 10 dB from 4 kHz to 20 kHz. Low
frequency noise reduction begins at 200 Hz, ul-
timately reaching 20 dB @ 20 Hz. Passive sub-
sonic filter rejection of — 35 dB @ 5 Hz.
Weighted overall noise reduction is — 10 dB
from 20 Hz to 20 kHz.

TAPE MONITOR: Two tape switches per-
mitting any input source to be recorded on
either of two tape machines, play back selection
of either machine, or copy of tape machine 2 on
to 1 while listening to a second source.

POWER SWITCHING CAPABILITY:
Switched outlets are capable of switching up to
25 amperes.

POWER CONSUMPTION: Preamplifier; 40
watts.

SIZE: 19" wide x 7" high x 10" deep.

WEIGHT: 18 pounds.



Phase Linear CORPORATION

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