

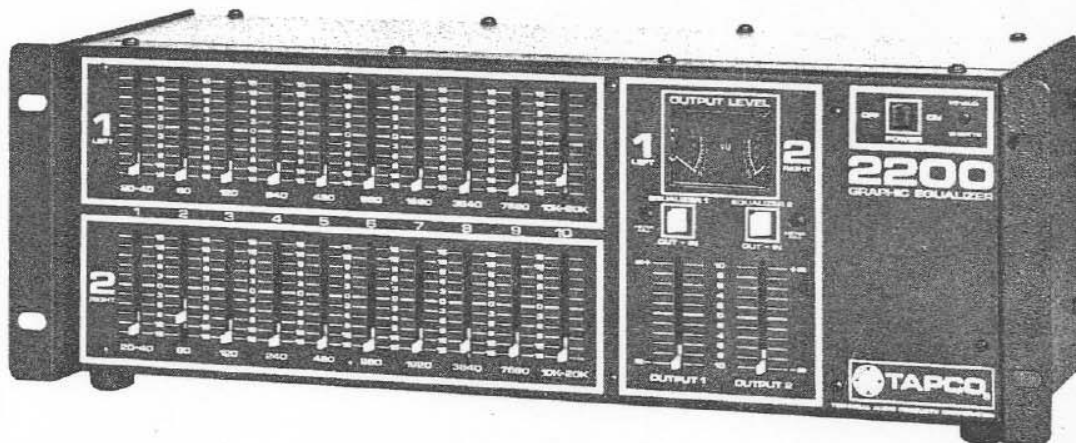
1. Introduction

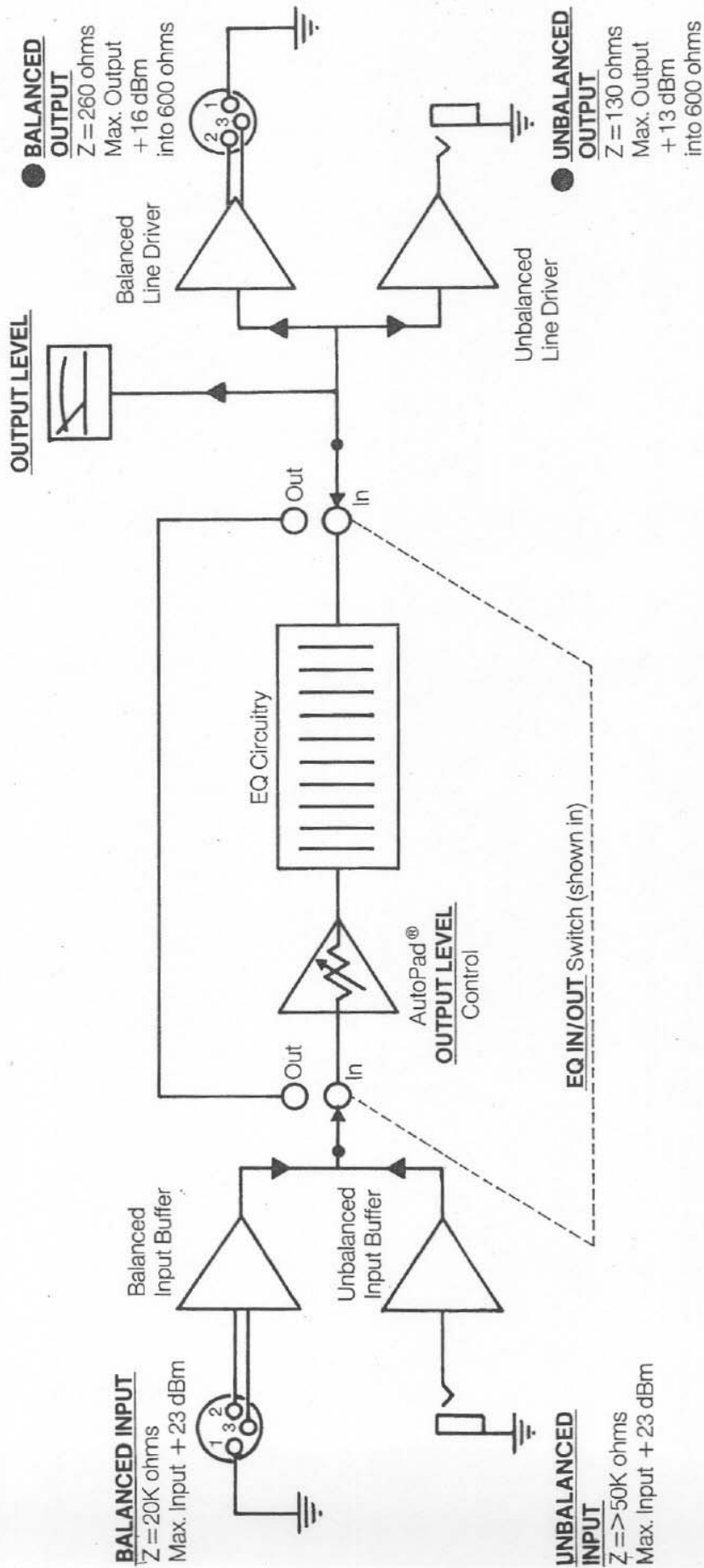
The Tapco 2200 Graphic Equalizer is designed to help solve some of the most common problems encountered in recording, sound reinforcement, broadcasting and industrial sound systems. Because the 2200 is intended for use in professional applications, it has many features not usually found on low cost graphic equalizers. For instance, both balanced and regular unbalanced inputs and outputs are provided, and may be used in any combination. This allows the 2200 to be used between balanced professional equipment, and unbalanced semi-professional or hi-fi equipment, without transformers or extra converters. Built-in line drivers remain in the signal path even when the equalizing circuitry is switched "out", making the 2200's output impedances constant at all times. This allows the equalizer to drive any line from high to low impedance, balanced or unbalanced circuitry. And, the 2200 can be used as a booster for weak signals, another feature that allows it to interface directly between pro and semi-pro gear. Each channel has its own EQ In/Out switch, so it can be programmed and compared against the non-equalized signal independently. This allows the 2200 to be used with two different program sources — like the main and monitor systems in sound reinforcement, or two channels of a multi-track recording. Meters constantly monitor output levels, so you can see (as well as hear) the level changes caused by equalization. And of course, the 2200's rugged rack mount design fits standard 19" equipment racks without adapters.

Equalization is the essence of the art of true sound reproduction. Sound engineers who understand equalization are able to achieve consistently high quality results in any situation. Equalizers are used

throughout the recording process: to insure that the frequency response of the studio monitors is as flat as possible; to correct the frequency response deficiencies of microphones and recording rooms; to help create a perfect mix by reducing conflict between instruments (or by highlighting a particular vocal or instrumental quality); and to create special effects. Sound reinforcement engineers use equalizers to smooth the composite frequency response of the microphone/speaker/room combination, to eliminate feedback problems, and to optimize monitor system intelligibility. Because equalizers are used so many different ways, for so many different reasons, they are perhaps the most misunderstood piece of sound equipment available today. But in actuality, equalizers have one main purpose — to make good sound sound good.

The Tapco 2200 Graphic Equalizer has all the functions necessary to serve as a creative problem solver. The absolute versatility of this equalizer gives it plug-in compatibility with virtually every sound system. Used properly, the 2200 will only solve problems, never cause them. Used improperly . . . well, that's what this Owner's Manual is for. A few minutes spent reading this manual will definitely save you a great deal of time in setting up and learning to operate your 2200 with the rest of your system. These few minutes will prevent any damage that might result from "user negligence." Tapco warrants the 2200 against just about everything, except misuse. As you can probably tell, we at Tapco want nothing more than the best possible sound quality. We'll do anything we can to help you get that quality in your system. If you have any questions after reading the Owner's Manual, please do not hesitate to contact your dealer or Tapco.





2. 2200 Block Diagram

Here is a very much condensed view of the circuitry inside the 2200. Refer to this diagram as you study the functional operation of the equalizer. It will serve as a "road map" as you move through the descriptions of the 2200's connectors and controls. Only one channel is shown.

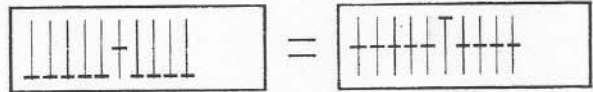
3. 2200 Control Functions

The control panel of the 2200 Graphic Equalizer has been human engineered for ease of operation in any situation. The equalizer section sliders are grouped by channel, with one channel directly over the other for quick comparisons. The output level controls, EQ In/Out switches and output level meters are grouped vertically so the overall performance of either channel can be checked at a glance. In addition, the channel markings are color coded — channel 1 being white, and channel 2 blue.

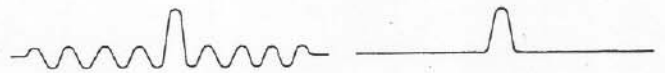
Each of the 10 slide controls in the equalizer section governs the relative loudness of one octave of the audio spectrum (20Hz to 20KHz). The frequency affected *most* by each slider is marked on the front panel of the 2200. In the drawings on page 5 you can see the direct relationship between each control and the entire audio spectrum, and the shape of the response of each control. The bands are broader when smaller amounts of the control range are used, and become narrower as the boost or cut is increased. This gives you control over somewhat more general bands when you need it, and more specific control when you need the greater selectivity. The "Q" (selectivity) of the 2200's EQ bands has been selected very carefully to give the best sounding results. You will notice on the response graph that the "Q" of the upper two bands is slightly lower than the rest of the bands. This small change in the response of these two bands allows them to be used much more ef-

fectively. Each slider has a 30dB overall range, +15dB (boost) to -15dB (cut). But remember: **FOR BEST RESULTS THE EQUALIZATION CONTROLS SHOULD BE KEPT AS CLOSE TO CENTER AS POSSIBLE.**

There are two reasons for this: 1) The overall sound you get with all controls cut 15dB (except one, which is at 0) is much the same as the sound you get with all controls at 0 (except one, which is at +15dB).



Even though these two control settings may sound very similar, they are actually quite different. When all the EQ sliders are cut 15dB a great deal of "ripple" becomes evident in the frequency response. If the response of the two EQ settings shown above were graphically plotted, they would look like this:



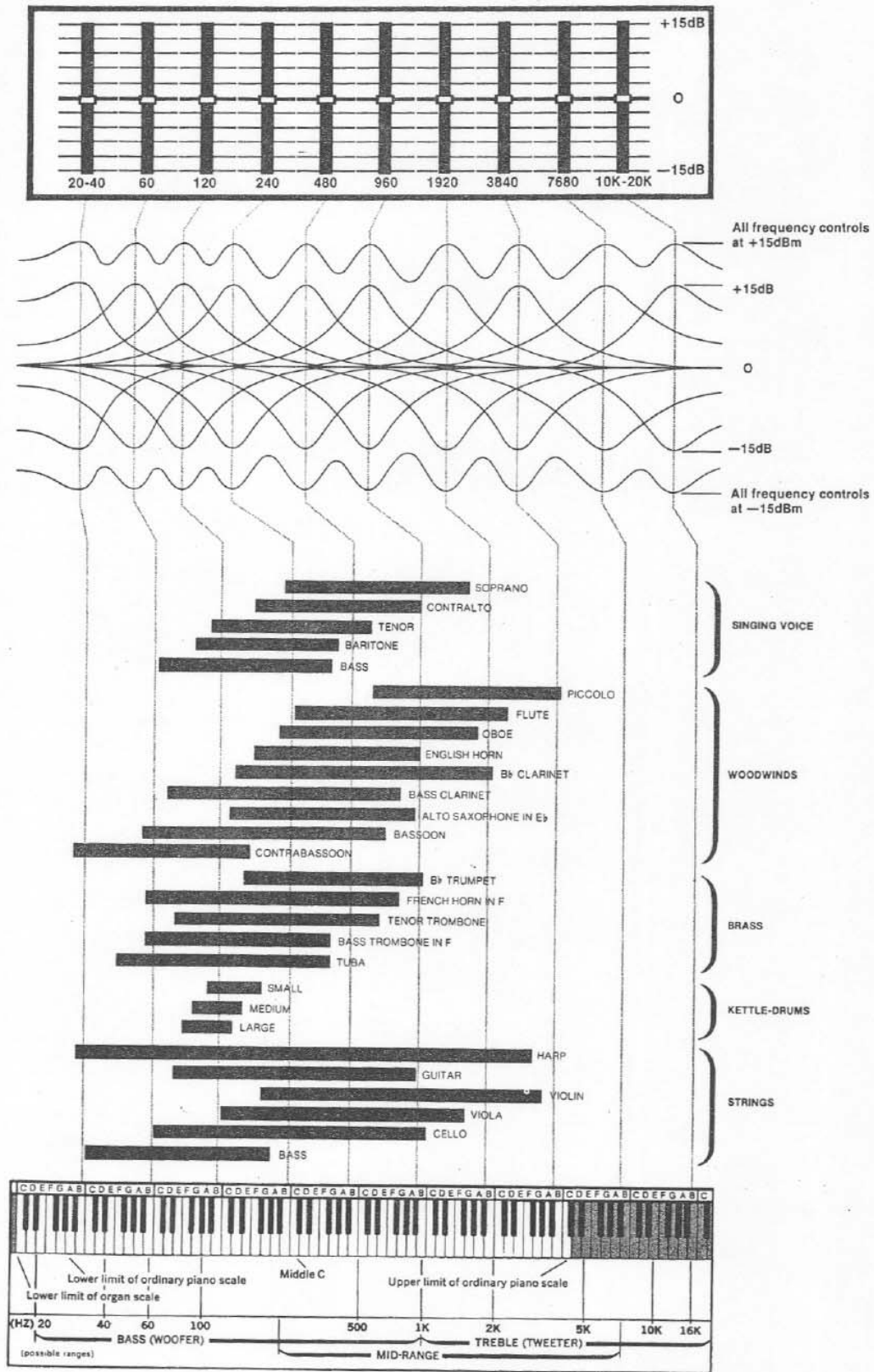
2) The other reason the controls should be run as close to 0 as possible will become evident as you begin to hear the subtleties of equalization: A little EQ goes a long way. There are extreme cases, of course. But generally speaking, any component in your system that raises the need for a full 15dB of equalization probably ought to be replaced!

For a more complete description of the equalization process, turn to Section 5, "How to use the 2200."

NOTES:

THE FREQUENCIES OF MUSIC

(Ranges of fundamental components of tones for the principal instruments and voices)



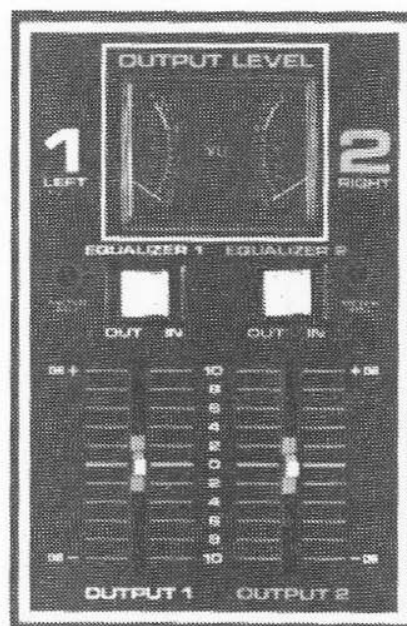
Only the fundamentally generated frequencies are shown. Harmonics are extended both above and below these fundamentals, and are controlled by the EQ bands at the outer ends of the spectrum.

The **OUTPUT LEVEL METERS** constantly monitor the actual signal level at the 2200's outputs. The meters are calibrated at the factory to indicate 0 VU at +4dBm. The meter calibration controls are accessible through the front panel. To change the meter reference level, insert a small flat blade screw driver through the panel hole, and into the slot on the calibration control. If you want the meter to read 0 VU at a lower level (0dBm, for instance), turn the control clockwise.

The **EQUALIZER IN/OUT** switches put the equalizing circuitry either in or out of the signal path. Two separate switches are provided so the 2200 can be used for two separate program sources, as well as for the usual stereo pair.

The **OUTPUT 1** and **OUTPUT 2** controls adjust the level of the *equalized signal only*. Notice on the block diagram that the output controls actually come *before* the equalizer circuitry, and that these are AutoPad gain controls. This is a very important feature of the 2200, and must be considered in the operation of the unit.

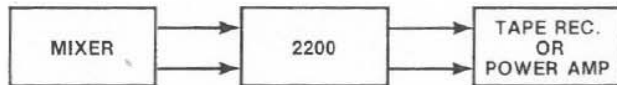
The primary function of the output level controls is to keep the 2200 functioning as a unity gain device, but they do have another very important function. When comparing the equalized and non-equalized signals (with the EQ In/Out switches), the levels of the two signals must be perfectly matched. This is because the frequency response of the human ear is very different at different volume levels. In fact, even slight differences in sound pressure level will cause the ear to perceive qualitative change. So, to be sure you really know what you're listening to, use the meters to match the levels of the equalized and non-equalized signals carefully. If the EQ controls have been used to *increase* the level of any of the 10 bands, you will probably have to *decrease* the output level control to match the original signal level. And, vice versa.



4. 2200 Input and Output Connections

The 2200 Graphic Equalizer is designed to be used in systems where any combination of signal processing equipment might be necessary at any time — situations that usually require jungles of wire and extra adapters of every description. This is why the 2200 has both balanced and unbalanced inputs and outputs, and why they are made to be used in any combination. As an example, the unbalanced input could be used while both the balanced *and* the unbalanced outputs are used, each driving a separate piece of equipment.

The 2200 is designed for use with line level signals. This means it should always be put into the sound chain *after* the preamp or mixer. The 2200 *can* be used to boost weak preamp or mixer signals, but it is *not* intended to be used as the preamp in a system.

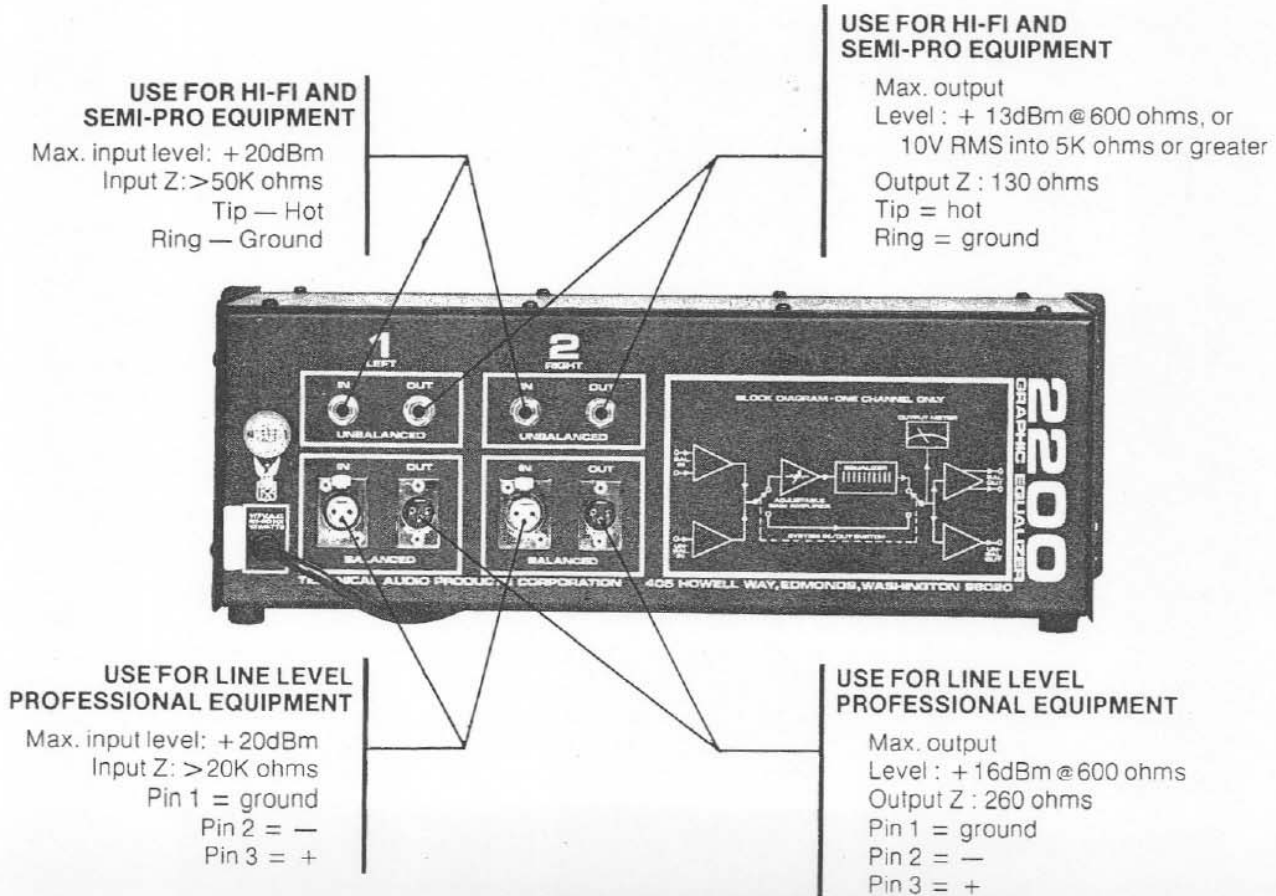


This is the basic set-up that will most always be used with the 2200, although many other ways to use it are described back in Section 6. No matter how you hook up this equalizer the output impedances will always be

matched, because the line drivers remain in the circuit path even when the equalizing part of the circuitry is switched "out". These line drivers are like little power amps, and like most power amps, they're short circuit proof. The best way to find out how the 2200 works with another piece of equipment is to plug it in and try it! Even if the two devices turn out to be grossly mismatched, you won't damage the 2200. **CAUTION:** ALWAYS CONNECT OUTPUTS TO INPUTS, AND INPUTS TO OUTPUTS. The 2200's circuits are fully protected against damage from abnormal signal levels, but the other gear you have may not be. So be careful!

The **UNBALANCED** connections are used for all the usual hi-fi and semi-pro kinds of equipment. Among this group are preamps, mixers, reverb units, reel to reel and cassette recorders. Always use the "High Level" or "Line" inputs and outputs on associated equipment when making connections to the 2200. And, always use shielded cables. The input cable to the equalizer should be kept as short as practical, but the output cable can be as long as you like (even a mile!). Again, if you want to know if it'll work, try it.

The **BALANCED** connections are used with any professional equipment that has balanced circuitry. This includes mixers, tape recorders, compressors, limiters, digital delays, reverbs, etc. Again, all connections should be to high level lines. The balanced outputs will put out +16dBm if necessary, although the nominal output level is the standard +4dBm.



5. How to use the 2200

When you install an equalizer in your sound system, you are giving yourself complete control capability. Equalization is really where art and science come together — the realization of creative technology. With a graphic equalizer you can actually *create* the sound you want. You can make sounds that would never be heard without the equalizer. A perfect example of this kind of sound enhancement can be heard on nearly any recording. The multi-track recording process has allowed recording engineers to completely separate and analyze each of the many sounds that make up a complete musical ensemble. This closer examination made it apparent to the engineers that something had to be done to make the composite sound seem more real. This is how equalization came to be used so heavily in recording. At this point, creative equalization of nearly every microphone channel used in a recording is quite commonplace. The original intent was to make recordings sound more real, and in fact recordings do sound more real these days. Beyond absolute realism, of course, lies sound enhancement. Because equalizers are able to completely reshape the frequency response of any sound source, they can also reshape the reproduced harmonic structure of musical instruments and voices. This ability to exercise complete artistic license with sound has given recording engineers the ultimate choice, and has given listeners recordings that (in many cases) actually sound better than the real thing.

What is flat anyway?

The recording process is probably the most extreme example of the creative potential of the graphic equalizer. But, this process is very representative of the one most basic use of equalization — that is, to perfectly tailor the quality of any sound to any situation. In most sound reproducing (as opposed to recording) systems, you will get the best quality sound when the system is providing flat response. Of course, flat frequency response is the elusive butterfly of the sound business, and in reality is not attainable. This is because even the finest individual system components cannot, by themselves, overcome the irregularities of the listening environment. Reasonably flat response, $\pm 3\text{dB}$ for instance, can be obtained only in very well designed acoustical environments using graphic equalizers guided by highly sophisticated instrumentation. But *anyone* can make a very good approximation of flat frequency response with a little ear training and an octave band equalizer like the 2200. And ultimately, it is your ears that will be the judge anyway.

Why all this business about flat response? Only because "flat" is the starting point. Only when a system is reasonably flat can we begin to make qualitative judgements based upon some standard. The mere ownership of a graphic equalizer forces you to make these qualitative judgements, and to tune your system accordingly. It may well be that you will end up with a frequency response that is far from this so-called flat, but it will suit your own taste, and you will know how it got that way.

General Playback Equalization (how to get there from here)

Use the hook-up diagrams in the next section of this manual to make the initial connection of your 2200 to the rest of your system. In lieu of high cost spectrum analyzers, calibrated microphones and pink noise generators, our only required piece of "test gear" is an FM radio — any old radio will do, as long as you can connect it into the system easily. Be sure everything is hooked-up properly, and turn the system on. Set the FM tuner between stations, where you get nothing but that rushing river sound. (Switch the muting circuit off, if there is one. And, be sure bass and treble controls are set "flat.") Set all the EQ controls on the 2200 at "O", and turn the volume of the noise up to the same level you will use when listening to music. Now, listen very carefully to the relative balance of the whole range of noise that you hear. If your system is perfectly flat, you will hear every portion at exactly the same volume as every other. If it is not, certain segments of the spectrum will seem to be missing, while others are exaggerated.

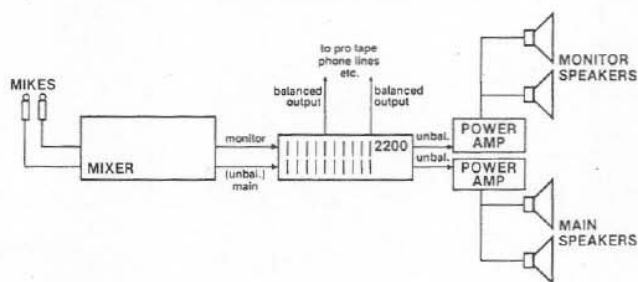
Perhaps you will not hear some of the extreme high and low frequencies very well at all. By trial and error you can locate the EQ slider on the 2200 that corresponds to the parts of the spectrum that are in need of adjustment. Move the EQ controls very carefully — you will probably be surprised at how much real control is available from each slider. By a selective process of balancing the different EQ bands, you can smooth out the sound of the noise 'till no segment seems to be missing, and no segment seems to be exaggerated. REMEMBER: THE FREQUENCY RESPONSE OF THE HUMAN EAR IS DEPENDENT UPON LOUDNESS. You must be sure that the equalized signal is heard at the same overall volume as the non-equalized signal to make a fair comparison between the two. This is one of the reasons the 2200 is equipped with VU meters. When you use the Output Level controls to match the signals the actual meter readings are not important. But it is important that the meters show the same level for both the EQ'd and the non-EQ'd signals. Also bear in mind that no one EQ band is completely independent. The bands are purposely designed to overlap so the final equalized response will not have any great peaks or dips. Every time you adjust one band, you may also have to adjust the adjacent bands to keep the response characteristic you originally aimed for. The process is simply one of adjustment, comparison, adjustment, and so on. Again, remember to set the Output Level controls for unity gain (no change) while making these comparisons. (You can use the 2200 as a booster amplifier later on if you need to.) Once you have arrived at the settings that seem to give you uniform response, put on your favorite record (hopefully one that's well engineered!). It will probably sound very different from the way you're used to hearing it, but leave the EQ controls this way until your ears have had a chance to thoroughly adjust to this new sound. If your system is in fact equalized for a more uniform total response, you will be hearing that record the way it was intended to be heard for the first time. Every record has a different "sound," and that sound didn't just get there by accident. It may well be that the particular quality of every

record in the world is not exactly to your taste, but you can be sure that the sound of the record is intentional. You may want to adjust your equalizer to improve the sound of a particular recording, now that you've heard it flat. If you do, make a note of the settings of the EQ controls as they are in the flat position, so they can be easily re-set.

This general equalization technique can be applied to any sound system to get an approximation of flat response. It should be stressed, however, that no matter how flat your system is — if it doesn't sound good, it doesn't sound good. The whole idea is to improve the sound, and that's what the 2200 is for.

6. Specific Applications

SOUND RE-ENFORCEMENT



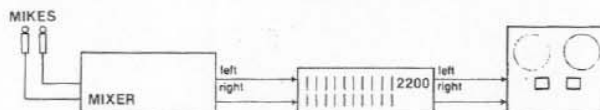
For general program equalization the 2200 can be connected between the mixer and the power amplifier(s). Use whatever combination of inputs and outputs are necessary to properly terminate the mixer and feed the power amp. Remember that *both* outputs on the 2200 can be used at the same time. This allows you to drive a power amp with the unbalanced output, and a tape recorder, phone line, etc. with the balanced output. When you adjust the EQ for the best sound, just be sure that no one segment of the audio spectrum is exaggerated and that no one segment is missing. When you can hear *everything* clearly, you've got the right EQ. If you are adjusting the system response for a situation that is likely to reoccur, make a note of the EQ settings so you can generate the same performance levels more quickly the next time around.

To help eliminate feedback in a PA system, the 2200 is installed between the mixer and power amp, as usual. Make the sound check with all the EQ controls set flat. After you have a good mix, slowly increase the system gain until feedback begins to develop. The frequency at which the system is ringing, or beginning to feed back, may be reduced by lowering the corresponding slider on the 2200. Which slider? You'll just have to fish around 'till you find the right one. The ringing will diminish when you adjust its corresponding frequency band — you'll know when you find it. Once you've per-

formed this operation a few times, you'll be able to tell pretty quickly which slider will control the offending frequency. A word of caution: Octave equalizers have rather generalized EQ bands (compared to a third octave equalizer, for instance). This means that every time you decrease the level of one of the EQ bands, you may be impairing the overall quality of the program material. The 2200 *can* be used to suppress feedback, but moderation is in order.

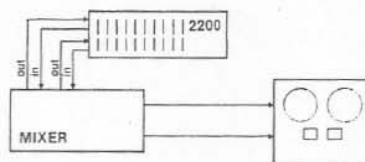
For stage monitor equalization, the 2200 should be connected between the mixer's monitor mix output and the power amp that drives the monitor speakers. When equalizing stage monitors you may want either maximum quality, or maximum intelligibility. If the vocalists are real nervous about how they sound out front, you will probably have to make the monitors sound as good as possible to allay their fears. But sometimes you can't get the best sound without feedback problems, so you have to sacrifice some overall quality for greater intelligibility. You can use the same techniques here as in eliminating feedback from the main speakers. Equalize the system under the same conditions you would ordinarily encounter during a performance. Have the musicians play one of their usual tunes, then adjust the EQ so the monitors "cut through" clearly. In the absence of the music the monitors probably won't sound so hot, but they *will* do the job of keeping the band together during a performance.

RECORDING



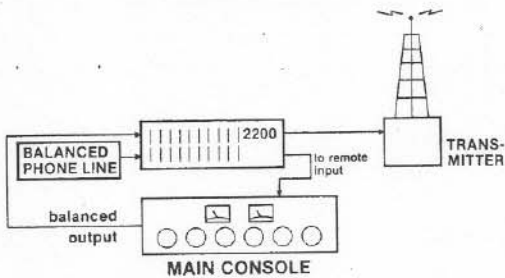
The 2200 may be put into the recording chain between the mixer and the tape machine. If a professional recorder is being used, the connections should be made to the 2200's balanced outputs. Remember that you can use the balanced and unbalanced inputs and outputs in any combination — even both outputs at once.

INDIVIDUAL CHANNEL EQ



The 2200 can be used for individual channel EQ with any mixer that has channel patching, or accessory send/receive jacks. Just put the 2200 in the loop created by the patching output/input, and adjust the EQ controls for the particular quality you want. The output level controls should be adjusted for unity gain, so the mixer is allowed to operate at the levels for which it is designed. The drawing shows how the 2200 might be used to equalize two input channels with a Tapco 6200A or B mixer.

BROADCASTING



The 2200 Graphic Equalizer is ideally suited for use as a combination telephone line and transmitter equalizer. Telephone lines used for remote broadcasts very frequently are not of the highest quality. Even Class A lines have been known to suffer from frequency response deviations. One 2200 installed in the main control room can take care of the phone line, and equalize the transmitter's signal too.

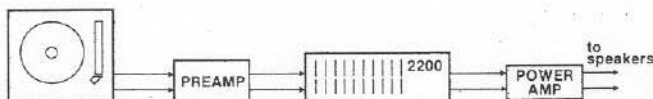
Transmitters (especially older models) are often plagued by strange modulation noises and poor high end frequency response. With an equalizer in the line between the studio and the transmitter those frequencies causing modulation problems can be gently reduced, while the high end is slightly increased. The result is a cleaner signal, lower listener fatigue, better ratings and increased billing!

This entire situation is easily handled by one 2200. Each channel is completely independent, so it can be used for two completely different signals.

In addition to phone line and transmitter EQ, the 2200 is often used to create a "sound" for a particular announcer. It has been common for some announcers to have their own microphone, and thereby their own sound. But with the 2200, everyone can use the same mike, with the "sound" generated by the equalizer. This lets all the announcers be happy with the same mike, saving the expense and headaches caused by having to use many different mikes to please all the announcers. Of course, spot production can be greatly improved as well!

Balanced circuitry makes the 2200 compatible with all professional studio gear. Built-in line drivers allow the 2200 to drive any line, and the output level meters provide level monitoring at all times. This makes the 2200 the ideal equalizer for broadcast use.

HI-FI OR DISCO



To equalize a stereo sound system the 2200 is connected between the preamp and the power amp. Use the unbalanced inputs and outputs.

INDUSTRIAL

Paging systems operating in noisy environments often cannot be heard. However, equalization can usually correct this problem. With the 2200, one channel of the equalizer is used to overcome noise problems in the manufacturing area, while the other channel is used to make the paging/music system more pleasant sounding in office areas.

SPECIAL EFFECTS

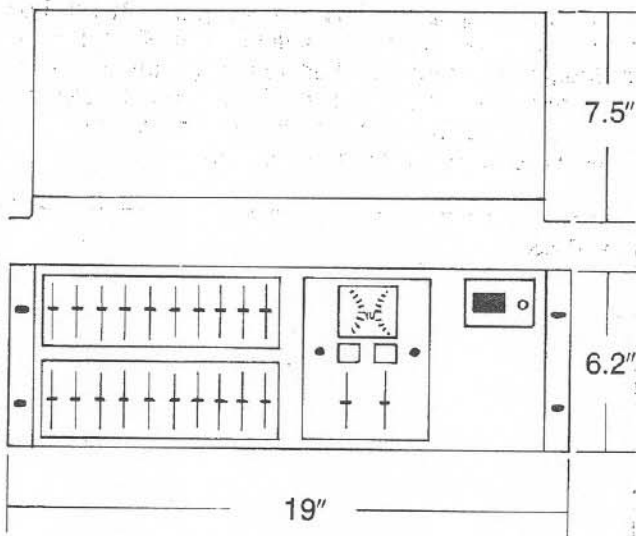
Perhaps the simplest and most noticeable effect that can be created with the graphic equalizer is the telephone (or filter mike) effect. Just remove most of the high and low end response from the signal by putting all but the middle two or three EQ sliders all the way down. The effect is further increased by putting the 960Hz band all the way up.

Mono recordings can be made to sound more like stereo with a graphic. The mono signal is fed to both channels of the equalizer simultaneously. Each channel is equalized differently, then fed to a stereo system. This effectively "spreads out" the sound, and can enhance the perceived quality of a mono recording when it is played or recorded in stereo.

NOTES:

7. 2200 Specifications

GENERAL	
Frequency response	10 Hz to 40 KHz ± 1 dB
Distortion	Below .1% at + 10 dBm output
Signal to noise ratio	Better than 80 dB, typically 85 dB
OUTPUTS	
	Balanced and conventional single ended
Max. output level	Better than + 12 dBm into 600 ohms or 10 volts RMS into 2000 ohms or greater
Impedance	130 ohms single-ended 260 ohms balanced
INPUTS	
	Balanced or conventional single-ended
Max input level	+ 20 dBm
Impedance	Greater than 50 K ohms single-ended Greater than 20 K ohms balanced
Equalizer control range	± 15 dB



8. References

Where to get more information

Modern Recording Techniques by Robert Runstein, published by Howard W. Sams Co. *The* complete modern text book of studio recording techniques.

Modern Recording is a bi-monthly magazine from the Recording Institute of America. MR covers equipment techniques, actual studio sessions, etc.. This magazine is highly recommended to anyone interested in recording.

Modern Recording
Recording Institute Publishing Inc.
15 Columbus Circle
New York, N.Y. 10023

Recording Engineer/Producer is another very good bi-monthly magazine dealing with the recording arts.

Recording Engineer/Producer
P.O. Box 2449
Hollywood, CA 90028

Basic Audio by Norman Crowhurst, is available from the John F. Rider Publishing Company. This book is just what the title implies.

Microphone Primer by Jim Long available from Electro-Voice, 600 Cecil Street, Buchanan, Mich. 49107. The basic guide to microphones.

The following are available from:

Sagamore Publishing Co. Inc.
1120 Old Country Road
Plainview, N.Y. 11803

DB Magazine — an authoritative, well known magazine, dealing with recording, sound reinforcement and general audio topics. Monthly.

Microphones: Design and Application by Lou Burroghs. The author was one of the two original founders of Electro-Voice, Inc. He is responsible for a great deal of today's accepted microphone theory and design. The book is a practical, non-theoretical reference manual for anyone in the audio industry.

The Technique of the Sound Studio by Alec Nisbett. This is a handbook on radio and recording techniques, but the principles described are equally applicable to film and television sound. 264 pages; 60 diagrams; glossary, indexed.

Modern Sound Reproduction by Harry F. Olson. This basic text covers amplifiers, microphones, loudspeakers, earphones, tape systems, film sound, tv and sound reinforcement — the significant elements and systems of modern sound reproduction. Employs simple physical explanations which are easily understood without special engineering training. 328 pages.

We might suggest that instead of investing your hard earned bucks in any of these publications on our word alone, go down to your library and look them over first. That much, at least, is free.

9. Accessories

Channel patching cord — for musical instrument equipment
Tapco part number **910002**

Channel patching cord — for hi-fi type equipment
Tapco part number **910001**

The Apple Box rack mounted carrying case (holds TAPCO mixer, equalizer and reverb in one box)
Tapco part number **910100**