



THE PA BIBLE

ADDITION NUMBER NINE

MIXING FOR THE LIVE PERFORMANCE

1. INTRODUCTION

Prior PA Bible additions have discussed speakers, microphones and their characteristics as applied to PA installations for the musician. The variety of subjects covered is shown in Figure 1, which lists all of the previous additions and their content.

While Addition No. 5 discusses the interconnection of equipment, no discussion of the control of the sound system elements was included. That, we felt, was the proper subject for a separate PA Bible addition; hence, the following discussion of "Mixing for the Live Performance".

Having discussed in some length the major elements that comprise the input and output of a PA system, it is appropriate that we now discuss the manner in which these signals are combined and directed. For the most part, this means discussing the procedure by which microphone and amplified instrument signals are combined, amplified and connected to loudspeakers.

The gear used to accomplish this task is called a "mixer". The operator is also called a "mixer". As the term is often used in PA sound work, the mixer is the operator but also has the overall responsibility for the PA system, including the microphones, amplifiers and loudspeakers.

While our discussion will center on the routing and control of the electrical signals comprising the main outputs of the mixing equipment, we will include those elements of the overall system that seem applicable. In effect, we are interpreting the phrase "Mixing for the Live Performance" in the broad sense, and will discuss the planning, set-up and operation of the PA system. While it is our intent to make this a broad discussion of mixing, we do not intend to cover the "art" of mixing, since we feel that the correct balance, equalization, loudness and overall "feel" of the sound varies from performance to performance depending upon the intent of the performance and the personal tastes of artists involved.

PA Bible Addition	Subject
Original Article	A Guide to setting Up a Speaker System for PA
No. 1	Drivers and Horns
No. 2	Speaker Power Handling Capacity
No. 3	Microphone Types
No. 4	Understanding Equalization and the Various Types of Equalizers
No. 5	System Interconnection
No. 6	The Constant Directivity White Horn White Paper
No. 7	Crossovers and Biamping
No. 8	Microphone Techniques

FIGURE 1 - PA Bible Additions

11. THE MIXER

The mixer is the equipment that combines, controls and directs the input signals to the required outputs, primarily program and monitor amplifiers. The inputs are usually from microphones with levels of -50 to 0 dBm or amplified instruments with levels from -20 to +30 dBm. A typical output from a PL80 dynamic microphone would be -40 dBm. By adjusting various input levels the mixer is used to provide a nominal line level program output of +4 dBm feeding a 600-ohm line. In P.A. applications this output is connected to one or more amplifiers, depending upon the particular set-up.

The mixer equipment provides a means for combining the various required inputs regardless of the differences in signal levels, and permits these combinations to be easily changed.

An important constraint on this equipment is that each audio signal must be preserved, and the mixer must not introduce distortion or modify the signal except by intention.

The primary element of the mixer is the channel. Each input signal is connected to a channel, and the number of channels in a mixer determines the number of signals that can be combined at any given time.

Figure 2 shows the basic elements of a single channel of a mixer.

A complete mixer consists of a number of these separate, isolated channels having the elements shown in Figures 2 and 3, combined into one main output (two for stereo) and a number of auxiliary outputs (such as monitor output). A commercial mixer such as the TAPCO C-12/Series Two, with expanders, may have as many as 44 of these separate channels.

The important features of a channel element include:

1. The phantom feed for electret and condenser microphones. This voltage is sometimes switchable.
2. Provisions for alternate line inputs. These optional inputs are usually higher level, unbalanced feeds, such as electronic organs and pianos, electronic guitars, synthesizers.
3. Attenuation prior to, or part of, the first stage of amplification. This attenuator (pad) is used to prevent overloading the first amplifier stage. Preventing overload and clipping of input signals is one of the most important elements of good mixing.
4. A gain stage prior to the fader and equalizers for an optimum signal-to-noise ratio.
5. Bridging connections which are electrically isolated from the main channel, providing monitoring, effects, and special device connections.
6. A fader to adjust the output of the channel to obtain the proper "mix" with mics and instruments from other channels.

These individual channels are combined in a variety of possible connections to provide, in addition to the main program output, a number of additional outputs. Figure 4 shows the block diagram of the TAPCO 7200 series which specifically illustrates these features. Only one channel is shown with the understanding that all channels are connected in parallel at each of the buses. In addition to P.A. speaker amplifier outputs, the inputs are bridged to provide solo, auxiliary, monitor, and effects signals that are electrically isolated from the main mixer output. These signals can be controlled separately from the main mixer output.

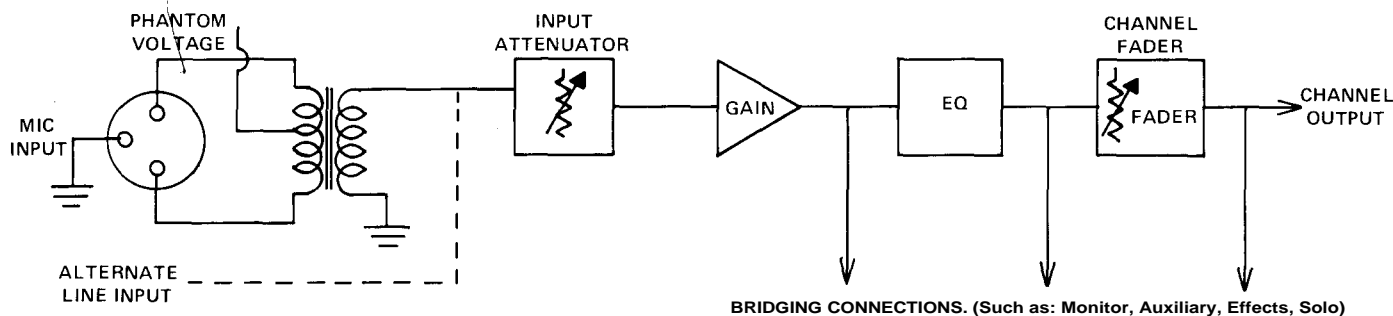


FIGURE 2 - Channel Schematic

The versatility of the modern mixer as exemplified by the 7200 series illustrates the complexity of the sound equipment that may be used for the music performance.

Separately controlled stage monitors, special effects and multiple microphone set-ups can add up to a very complex system and one that requires proper planning for success.

III. PLANNING

Planning obviously depends on the particular event and location and, of course, the "mixer's" relationship to that event; but, regardless of these constraints, certain basic information is required. Proper planning means having this information early, at least prior to the day of the performance. The required information includes:

1. The number of performers and their instruments.
2. A layout of the stage area showing the location of the performers.

3. Stage monitors required.
4. The size of the audience and theatre and location of audience and stage.
5. Sound level desired at the audience location.
6. Any requirements for special feeds such as recording and back stage monitoring.
7. Location of AC power outlets (or for large systems with many amplifiers, the circuit breaker box.)

Discussions with the performance organizer, performers and facility personnel prior to the performance are very important, if not essential. A visit to the location is essential.

From this information equipment requirements can be determined. Knowing the musicians, their location and the instruments they play, the number and type of microphones can be determined. Refer to PA Bible Additions 3 and 8 for information to assist in your selection. Microphone mounting requirements should be

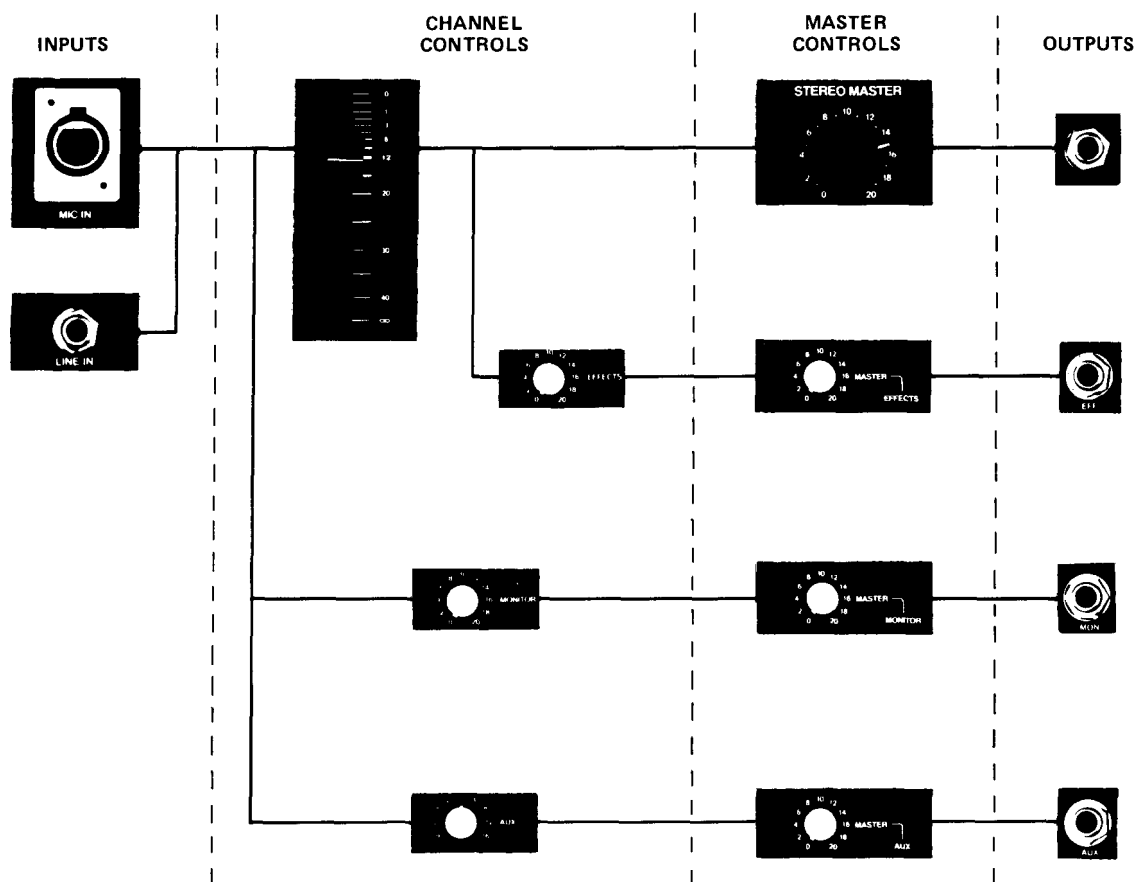


FIGURE 3 - Channel Pictorial

considered to determine the number of mic stands required, and any special mounting requirements such as boom mounts.

A layout of the stage area showing microphone positions combined with a knowledge of the physical plant permits a location for the mixer and amplifiers to be chosen.

Microphone and speaker cable runs (snakes) can now be planned.

With the number of mics determined and auxiliary equipment requirements known, the mixer requirements can be determined.

The size and physical layout of the "house" will determine the number and type of loudspeakers, and the size of the amplifiers that are needed. Consult the original PA Bible article and additions 1, 2, 6, and 7 for more information on power requirements and speaker placements.

Equipment requirements must be matched against the equipment available. Additional equipment may be needed. Limited equipment resources may require modification of the performance itself, with modifications in the number of instruments used or number of monitors requested.

Planning requires that these conflicts be worked out prior to the set-up. Needed additional gear must be obtained, and the prudent sound technician will test all new gear well in advance.

For large installations, check lists for equipment and tools are a good precaution. Without check lists, unusual items such as a flash light or paper labels are easily overlooked.

For maximum reliability redundant equipment should be provided whenever possible.

IV. THE SET-UP

The set-up can be considered in two steps:

1. Locating and interconnecting equipment.
2. Testing.

Location of equipment is fairly straightforward. Microphones are mounted on appropriate stands and placed at their approximate location. Loudspeakers are located in number and position by the size of audience and arena.

The amplifiers and any auxiliary equipment are located at one location whenever possible, and at a position where they can be viewed from the mixer position. The mixer should be in the audience area preferably, but, some performing facilities have specific areas designated that must be used.

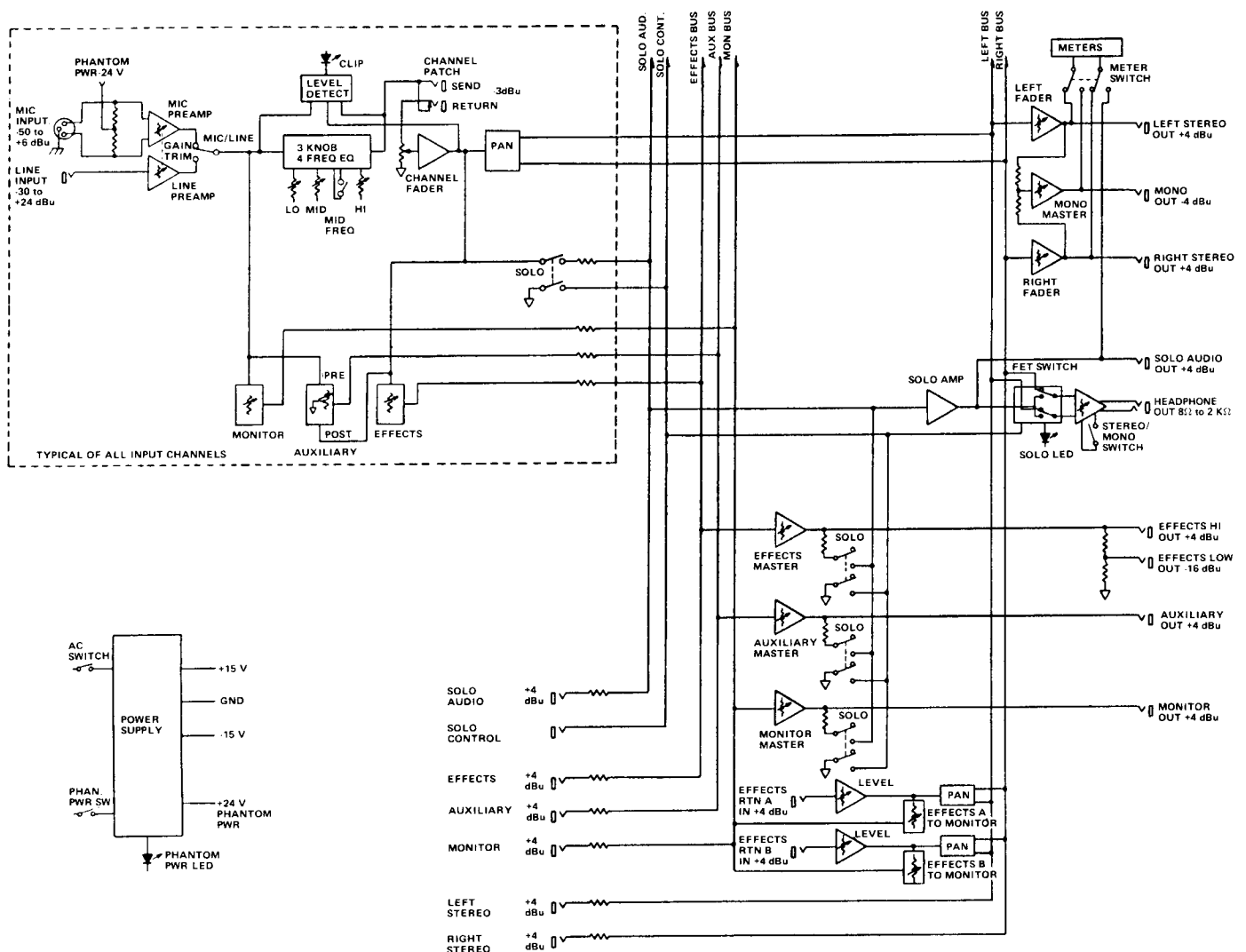


FIGURE 4 - Block Diagram Panjo 7200 Series

Prior planning will have provided the necessary tables and chairs.

It is essential that all equipment be tested as a part of the set-up and that vocal and musical inputs used for testing be near normal level. At this time, levels can be set and sound quality checked. There should be no indication of clipping, noise, distortion or feedback. Input attenuators may have to be adjusted.

A general procedure for testing and adjusting the system should include the following:

1. Equalize the main program outputs. This procedure may involve sampling microphones and sound level meters, or may simply use a known source and the mixer's ears.
2. Adjust input attenuators to prevent clipping, making certain that sufficient "headroom" is available.
3. Set the level on the vocal microphones.
4. Adjust instrument levels.
5. Set stage monitor levels and equalize to prevent feedback.
6. "Run through" each musical grouping for balance, sufficient level and lack of feedback.
7. Determine and adjust loudness of audience sound.

Overall loudness of the sound is a vital consideration. Loudness can relate to the quality of the performance and, also, to the audience being able to converse. Managers, owners, performers and the mixer can all be a part of determining the proper loudness.

Monitor and microphone positions should not be moved after the system has been adjusted.

During the set-up, consideration should be given to identifying the microphones on the stage and at the mixing equipment so that it is readily apparent as to which channel controls what microphone. With multiple microphones of the same model this can be tricky. Colored windscreens on microphones or colored wrapping on cables and connectors can be identified with a corresponding color patch at the matching channel on the mixer. Numbers or instrument and musician's names can be used to label each channel.

Proper identification of all inputs is absolutely essential.

A useful concept in mixing is to group inputs in adjacent channels, or to group inputs to feed sub group controls that are available on some mixers such as TAPCO 7400 Series. This grouping allows several microphones, such as those used on the drums, to be considered as a single unit and controlled as such. This reduces the number of elements in the set-up that require separate control. This is an especially useful concept for large installations.

It is also prudent to identify cables at a point near the connection to the mixer.

V. THE PERFORMANCE

The critical element of the music performance is that it is live and not subject to correction on a retake. Proper planning and rehearsal are the steps used to obtain a "smooth" performance.

For a performance with a number of acts and several band arrangements, a work sheet should be developed during rehearsal and used during the performance to guide the switching of inputs and control of levels.

Good practice will include switching off unused microphones.

Despite the best planning, unrehearsed, unplanned events often occur during a performance. Knowledge of your **equipment and of the particular set-up are the basic tools that can deal with the unexpected, including equipment failure.**

This knowledge will not only guide problem solving efforts, but will provide the confidence necessary to avoid panic.

Some specific actions that are useful in dealing with the unexpected include:

1. Using headphones and the "solo" **feature available on some mixers to isolate problems, particularly distortion, in a specific channel.**
2. Switching from an apparent dead microphone to a similar unused microphone in the same location.
3. Maintaining a supply of redundant mikes and cables.
4. Being able to quickly view all equipment to determine status, including clipping indicators.
5. Avoiding "cranking up" the gain when the signal level drops. Feedback is usually not far removed from normal settings. Knowing the feedback level for each control is helpful.

Despite the best intentions and preparations, "glitches" are likely to occur during live performances. The corrective actions available are limited. Knowledge of what is not possible or practical is as important as knowing the possible corrections. It is better to "live through" some problems than to thrash around making the problem worse - or at a minimum, calling attention to it. Experience is the best teacher in this regard.

Planning, preparation and experience are the necessities for the "live performance", that and a little luck.

We would appreciate receiving your comments about this addition or about topics for future additions. Please send your response to:

PA Bible
Electro-Voice Inc.
600 Cecil Street
P.O. Box 186
Buchanan, Michigan 49107



Electro-Voice® a gulton company
600 Cecil Street, Buchanan, Michigan 49107
8234 Doe Avenue, Visalia, California 93277
Electro-Voice Div., 345 Herbert Street,
Gananoque, Ontario - Electro-Voice, S.A.,
Rornerstrasse 3, 2560 Nidau, Switzerland