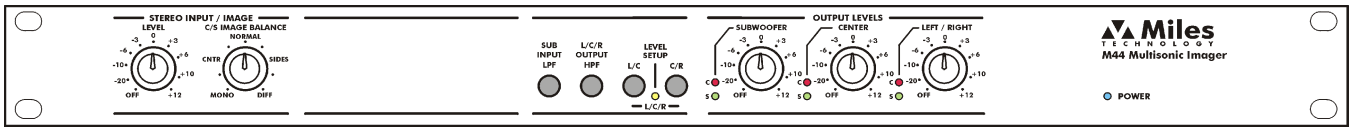
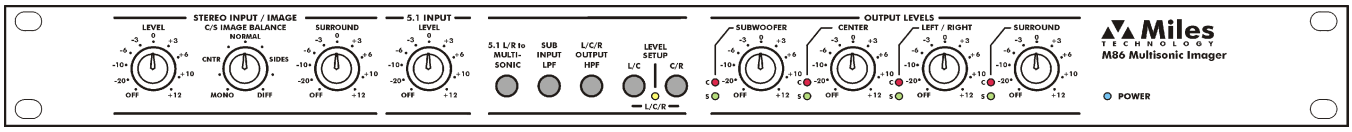
Miles TECHNOLOGY





M44 Multisonic® Imager
M86 Multisonic® Imager

Operation Manual

Miles Technology Inc. • Niles, Michigan • USA

ABOUT THE M44 and M86

Multisonic® Imagers are precision electronic audio devices which enable a sound system to provide the many advantages of stereo sound to off-center listeners. They also improve the stereo sound quality for all listeners.

Miles Technology's patented Multisonic Imaging System provides stereo sound localization using three loudspeakers for the front soundstage. Multisonic Imaging greatly increases the stereo listening area and improves the sound localization capability of any audio system. It works perfectly with practically all stereo program sources including live mixes and video soundtracks.

The sound quality of a Multisonic system is outstanding. It is suitable for high-end audiophile and home theater systems as well as the most demanding professional applications.

In addition to its Multisonic Imaging function, the M44 and M86 include a subwoofer output and subwoofer crossover filters for all inputs, as well as discrete center and subwoofer inputs for live productions. The M86 also includes a 5.1 input for surround sources, with its own level control, and SpreadSound™ derived-surround outputs which provide superb surround with all two-channel stereo sources.

The convenient control arrangement allows for easy setup and adjustment. These Imagers can operate without user intervention or adustment when changing sources, even with multiple types of signal sources.

The four main inputs and all six outputs are balanced with XLR connections, while the three auxiliary stereo inputs and the 5.1 inputs use gold RCA connectors.

Multisonic Imagers are unique devices and provide a huge improvement in the realism and fidelity of sound reproduction for both professional and home-theater sound-system applications.

M44 and M86 Quick Start Instructions

1. If possible save the box, packing, and your Authorized Dealer sales receipt, which validates the warranty period if it starts later than the date of manufacture. For units without this documentation, the three-year warranty starts at the last day of the month of manufacture as indicated by the serial number.

2. For intended operation, three loudspeakers are needed. They are placed at left, center, and right. If possible the center loudspeaker should be set back a little so that the three are equidistant from a point on the centerline and toward or at the back of the listening area.

   Each of the loudspeakers should be aimed for optimum audience coverage. Usually this is horizontally toward the center of the audience, and vertically toward the most distant listeners.

3. When used with a stereo mix, the Multisonic Imager is normally connected into the signal path just ahead of the amplifiers, active crossovers, and protective limiters. It should be the last unit in the signal path before the loudspeaker-specific processing.

4. Generally the loudspeakers and amplifier gains of left, center, and right are to be matched. An unmatched center loudspeaker can be accommodated also; in this case the gain setting may be different. The setup function allows quick, precise gain adjustment.

5. Use the Setup function to adjust the amplifier gains:

   A. Start with all output level controls on the M44/M86 at center position.

   B. Operate the system with a stereo or discrete center input signal.

   C. Press the L/C Setup switch. Adjust the left or center power amplifier gain control for a phantom sound source exactly midway between the left and center loudspeakers. Release the L/C Setup switch.

   D. Press the C/R Setup switch. Adjust the right amplifier gain for a phantom sound source exactly midway between the right and center loudspeakers. Release the C/R Setup switch. Setup is complete.

6. To adjust the derived surround level (M86 only) using a stereo source:

   A. Set the Surround Output Level to mid position or appropriate set point.

   B. Set the C/S Image Balance control to full clockwise.

   C. Adjust the Stereo Input (derived) Surround control so that the surround loudspeakers sound equal to or slightly louder than the front, when listening in the center of the listening area.

   D. Restore the C/S Image Balance control to center.

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1 Multisonic Imaging

Description

The Miles Technology Multisonic® Imaging System greatly enhances the acoustic sound quality of all stereo program sources using three loudspeakers rather than just two.

Multisonic Imaging is an electroacoustic audio imaging process which increases the clarity, focus, and listening area of a stereo sound system while using any stereo audio program source.

This is accomplished without the need for any special encoding process. It simply relies on amplitude panning, which is the method used on virtually all modern multichannel-mixed recordings, as well as many stereo-microphone recording techniques. It adds no distortion-generating dynamic modification or equalization. Nor does it rely on any type of “steering”. Multisonic Imaging is a linear, high-fidelity process that clearly and accurately presents the content of any program source, and is compatible with all stereo program material, as well as any playback medium including compact discs, cassettes, FM broadcasts, stereo television, stereo videotapes, and surround-sound videotapes. It also is used to great advantage for live sound productions, whether a two-channel stereo mixer or a discrete LCR mixer is utilized.

Stereo recordings will have increased focus, clarity, and listening area when the Multisonic Imaging system is used for playback. This is achieved using a Multisonic Imager and a center loudspeaker with comparable performance to that of the left and right loudspeakers. The Multisonic Imager, combined with correct loudspeaker placement, will result in superior audio performance in every respect.

Multisonic Imaging reproduces center-panned sound sources within the mix, such as lead vocals and kick drums, in the center. These center-panned sound source locations will be heard in the center, no matter where the listener may be located or what else is in the program mix.

Conversely, side-panned sounds radiate unmasked from the side loudspeakers. The spatial separation reveals nuances which can be lost in conventional setups. More output power, more headroom and less distortion also result through the effective use of three loudspeakers.

Rather than forcing the side loudspeakers to additionally reproduce the center sounds (mixed equally into the side channels), Multisonic Imaging, through the use of a separate center loudspeaker for center sounds, greatly reduces the stress on all of the loudspeakers.

Perhaps most importantly, the listening area in which a well-balanced stereo image can be heard is greatly increased. See **Figure 1** and **Figure 2**.

While a conventional system can provide localization for the extreme left and right positions, it relies entirely on producing a phantom image for the central area of the soundstage. The phantom image, with normal loudspeaker placement, only works when the listener is exactly centered, the left and right loudspeakers are well-matched, and the room acoustics are good.

The Multisonic Imaging System provides accurate imaging simultaneously for left, center, right, and all in-between soundstage positions. It can be thought of as two stereo loudspeaker pairs— left/center, and center/right—each creating a precise soundstage. The two halves then blend together perfectly since they share the center loudspeaker.

For any sound source location, each of the three loudspeakers contributes perfectly by virtue of its relative polarity and amplitude. This process works continuously across the soundstage for any source location. The final result, put simply, is this: it sounds much better!

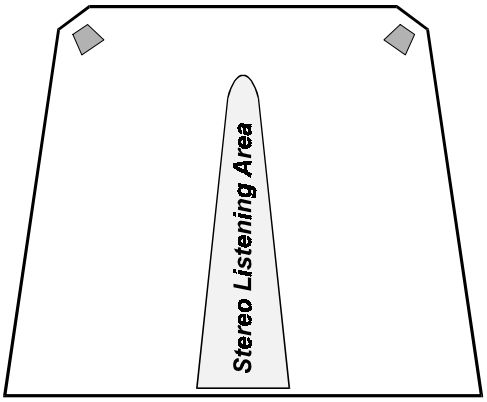

Fig. 1 Conventional Sound System

Fig. 2 Multisonic™ Sound System

Benefits

The Miles Technology M86 Multisonic® Imager will benefit a sound system in many ways:

Multisonic® Imaging
With patented Multisonic™ Imaging, the "sweet spot" is enlarged to practically the *whole room*, allowing an entire audience to simultaneously hear great stereo sound.

Designed For Professional Stereo
The M86 is designed for auditoriums, theaters, sanctuaries, nightclubs, A/V systems, corporate boardrooms, studios, touring systems, DJ systems, multimedia rooms, commercial and home theater, home audio, post production, and many other types of installed and portable sound systems.

Compatible With All Program Sources
The Multisonic Imager works perfectly with all program material, including compact discs, tapes, video, stereo-surround audio or video programming, broadcast, and live signal sources. It perfectly accommodates separate signal feeds for center or surround channels, using the balanced discrete-input connections.

Balanced Inputs and Outputs
All inputs and outputs include balanced connections for maximum signal integrity.

Discrete 5.1 RCA Inputs
This input connection accommodates a DVD player (which has analog outputs) for convenient integration into a 5.1 system. A separate level control is provided for this input to balance the system.

5.1-to Multisonic Switch
Most DVD's, with discrete center (and certainly those without), will benefit greatly with Multisonic Imaging. With this function, the sound will be an optimum combination of discrete 5.1 and Multisonic imaging.

Additional RCA Inputs
Three stereo pairs of RCA input connections are provided in addition to the balanced XLR inputs. These are for additional input sources. All of the stereo inputs are mixed together so that whichever device is active will be heard without any user intervention.

Subwoofer Crossover and Bass Management
The built-in fourth-order Linkwitz-Riley crossover filters provide an optimized subwoofer output derived from all sources, including 2.0 (two-channel stereo), 5.1, 5.0, 4.0, etc. Switchable high-pass filters allow optimization of the main loudspeakers' bass performance also.

Discrete Center and Subwoofer Inputs
These balanced inputs allow optimum use of the center and subwoofer channels with specific input sources during live productions.

Cleaner and More Dynamic Sound
Using three instead of two loudspeaker and amplifier channels, the sound is much cleaner with less distortion and more headroom. For the *same resulting sound level* each loudspeaker operates at *a lower power* and *lower distortion level*.

Superior To Discrete L-C-R Systems
Loudspeaker coverage limitations often prevent full-width soundstaging with discrete L-C-R systems because listeners at one side of the room may be unable to hear the loudspeaker on the opposite side. The M86 solves this, allowing more flexibility for the mix engineer.
In addition, it properly presents two-channel stereo signal sources with the sound system.

SpreadSound™ Surround Outputs
These outputs provide the *cleanest possible* stereo surround signal derived from stereo sources; it is much more natural than digital-delay or decorrelation methods.

Simple and Precise Setup
The task of balancing all the levels in a multi-channel system is simplified and the guesswork is removed. Setup is very quick with any signal source.

No Distortion
Multisonic Imaging is a completely high-fidelity process; it does not add harmonic, frequency, phase, or dynamic distortion. There is no "steering," and there are no unnatural digital artifacts or other side effects typical of other multichannel decoders. From a signal-quality standpoint, the Multisonic Imager is transparent.

Focused Center
Sounds intended to be at front and center are clearly localized there with excellent focus and intelligibility for all listeners. This improvement, compared to traditional stereo, is dramatic.

More Even Sound
A “wall of sound” is created which provides more even and well-balanced sound distribution while maintaining correct localization. Listeners hear the *sound stage*, not the loudspeakers.

Clarity Through Separation
The separation of sound into three channels brings a large reduction in loudspeaker distortion and a dramatic presentation of the sound stage.

Adjustable Or Actual Mix
The relative levels of center and side-panned sounds in a stereo mix can easily be adjusted with the C/S Image Balance control, making the sound distribution perfectly even. Or, the control can simply be left centered—resulting in a precise stereo image *exactly representing the input signal*.

Vocal Cancellation
The M86 can perform precise, effective vocal cancellation without loss of bass response.

Cost Effective
The M86 provides state-of-the-art sound with dramatic stereo quality at a *very modest cost*. The result is superior to that achieved using expensive discrete mixing systems or DSP processor-based systems.

Solid Warranty
Every Miles Technology product is made in the U.S.A. and is fully guaranteed for three years to operate as intended and specified.

Applications

There are many applications that can benefit from the use of Miles Technology' s Multisonic® Imaging:

Auditoriums and Performing Arts Centers: The Multisonic Imaging system makes the often-desired left/center/right front-of-house system a convenient reality. Vocal intelligibility is greatly enhanced by the center channel, and overall music program subtleties are brought out. Live mixes can be panned out for full stereo with results far superior to conventional two-channel systems and even superior to discrete L/C/R systems. Comb filtering problems and hot spots are gone. Almost all of the seats receive excellent, balanced stereo sound.

Sanctuaries: Multisonic Imaging provides a clear center channel that improves vocal intelligibility while also creating a much larger listening area receiving optimum, full-range sound. When live or recorded stereo music is played, everyone will hear the full stereo sound; when one is speaking through a microphone, the clarity, focus, and intelligibility will be dramatically improved.

Nightclubs: Stereo sound is more evenly distributed over the entire dance floor and audience area. Overall levels sound more impressive with the same SPL and with low distortion. Even with a loud, chest-thumping beat, patrons and employees will find it more practical to interact.

Foreground Music Systems: Music is often used to create an atmosphere at places like record stores or department stores. The idea is for music to be heard clearly and yet not be overpowering. Multisonic imaging achieves this, in addition to enhancing the drama and subtleties of music with the benefits of true stereo sound.

Touring Sound Systems: Multisonic imaging can be used for large or small touring systems, not only for effects and stereo playback, but especially as the primary imaging method for the entire mix. The vast majority of the audience will hear excellent stereo localization, and those who are very close to a particular loudspeaker system will still hear the entire mix, with sounds panned to the opposite side slightly down in level but still audible in the mix.

Home Theater Systems: Multisonic Imaging is ideal for home theater systems. Any stereo TV broadcast or videotape will provide outstanding results, superior to "steered" logic systems. Multisonic Imaging can image any and all directions simultaneously (steered systems can localize at only one direction at a time, resulting in frequent sound staging compromises). In addition, the Multisonic system provides superior playback with all audio program sources.

Portable Sound Systems: A Multisonic system will greatly enhance the performance of small portable systems, increasing coverage area and providing a "bigger" sound. The low cost and small size of the Multisonic Imager truly improves the performance quality of any portable audio setup.

Television and Radio Production: Quite often, control and production rooms at broadcast facilities present a difficult environment for accurate stereo monitoring of source material. The Multisonic Imager solves this problem by increasing the listening area so that several people in the control room can simultaneously hear the audio with correct stereo perspective. Any technical problems, such as loss of stereo or phase errors, will immediately be audibly obvious.

Recording Studio Monitoring: Stereo recordings can be optimally engineered to take full advantage of the increased clarity provided by the three-channel Multisonic sound. These enhanced results can also improve performance with conventional systems. Also, the increased optimum listening area of the studio control room will be greatly appreciated by all those who need to "listen in" during the mixdown process.

Stereo Processing: the Multisonic Imager is generally the best way to implement stereo-to-5.1 format conversion. The Multisonic Imager can also be used with stereo recordings for vocal cancellation. And it can restore lost separation in a stereo recording.

Home Stereo Systems: Using a Multisonic Imaging system is the very best way to listen to CD*s, tapes, broadcasts, or other program sources. Previously hidden detail in recordings will be heard. The loudspeakers will sound more at ease with program dynamics, and the listener no longer needs to sit in the center of the room to hear good stereo. The Multisonic Imager effectively converts all stereo sources to sound as good as or better than discrete 5.1 sources.

Theory Of Operation

The Multisonic® Imaging System is based on a patented linear-matrix audio imaging circuit, which creates three signals to drive three loudspeakers from a standard two-channel program source.

The Multisonic Imaging System electrically separates left, center, and right components, in the form of three electrical signals, from the left and right input signals. It then acoustically separates them by feeding the signals appropriately to three loudspeakers which are physically and acoustically located at the appropriate left, center, and right positions.

Each side-channel output has a portion of the opposite channel subtracted, with the exact proportion and level for the side channels precisely maintained, according to the C/S Image Balance control position.

The center channel is created by summing the processed left and right output signals. This signal will always be 6 dB higher (louder) with any center-panned signal information, compared to side-panned signal information. The exact level of the center channel is precisely maintained for correct operation. Once the system is set up, there is no need for concern about the center channel loudspeaker level. It is always exactly correct.

This concept, combined with vector-sum acoustic imaging—the process which creates a phantom image between or beyond two or more loudspeakers—results in any two loudspeakers effectively reinforcing the imaging location of the third loudspeaker. This increases the perceived separation between any two of the three channels beyond that provided by the electrical separation.

The Multisonic Imager creates the theoretical maximum of 6 dB of electrical separation between any two of the three channels. This in itself is enough to effectively localize a sound source, but the separation is further increased subjectively with the use of quality loudspeakers and a good acoustic environment. The acoustic interaction of the three loudspeakers causes a focusing effect which can eliminate the perception of any electrical crosstalk. When a signal is panned to a particular loudspeakerlocation, the other two loudspeakers will effectively reinforce that loudspeaker*s imaging location. If a signal is panned to a location between the loudspeakers, all three loudspeakers together point to that specific sound-source location.

At the midpoint between left and center and between right and center, the opposite loudspeaker is canceled completely, leaving the two loudspeakers to create a phantom image midway between them. This is essentially the same principle that creates the phantom-center image in conventional left-right systems. But in this case the phantom locations at left-center and right-center will be more clearly defined because of the closer spacing (one-half the distance) between the adjacent loudspeakers in comparison to a two-channel system.

The C/S Image Balance control is integral to the Multisonic circuit. It allows adjustment of the matrix parameters which control the relative levels and effective width of the stereo sound stage. This allows compensation for any variation in the stereo width of the mix. Differences in image width or perspective can be caused by the use of different microphone configurations for the recording, as well as different playback loudspeaker configurations. The C/S Image Balance control can compensate for these factors so that optimum imaging can be achieved.

Alternatively, this control can be simply left in the center or in a preferred position. The system will then reveal what was recorded in the program material without the need for any user intervention.

2 The Multisonic® Imager

Stereo Inputs

The primary function of the M44 and M86 is to convert a standard stereo input signal, with left and right input connections, to a Multisonic output signal with left, center, and right outputs. In addition, a subwoofer output and two surround outputs are provided for a complete multichannel listening experience with any left-right stereo signal source.

Up to four stereo input pairs can be simultaneously connected to the M44 or M86. A pair of balanced XLR input connections are provided, as well as three pairs of RCA unbalanced inputs. These four pairs are mixed together to form the left and right stereo source. The RCA inputs have 7 dB additional gain compared to the XLR inputs. The input sources for left and right are separately mixed together at an equal ratio. The M86 can handle a fifth stereo input as part of the 5.1 connection (see below).

The Input Gain control allows adjustment of the level of the stereo input mix. The C/S Image Balance and Derived Surround level controls allow convenient adjustment for perfectly balanced sound staging of the stereo sources.

LED indicators show the output levels, which are adjustable using the Subwoofer, Center, Left/Right, and Surround output controls.

5.1 Inputs (M86 only)

A set of 5.1 input connections allows seamless integration of any discrete 5.1 source in the sound system. These inputs normally route to the corresponding outputs on the M86. A separate gain control is provided to adjust the level of the 5.1 source. This can be used with any DVD player that has 5.1 analog outputs (that is, it has built-in digital decoding).

A switch is provided to route the left and right inputs of the 5.1 source through the Multisonic process. This can be used for 5.1 sources which lack a center signal; the result will be much more effective

front soundstaging. Furthermore, this switch can be left on all of the time (used for all 5.1 sources); in virtually all cases the sound will be improved.

If a full 5.1 source is not used, the left and right connections of the 5.1 input can be used as an additional stereo input. In this case, the 5.1-to-Multisonic switch should be pressed, and the 5.1 level control will act as a separate level control for this stereo input.

Discrete Center and Subwoofer Inputs

Discrete balanced input connections are provided for center and subwoofer signals. These buffered inputs feed straight through to the corresponding outputs and are intended for live production work where discrete source signals can be created at the mix console and routed directly to the appropriate loudspeakers. This is very effective for center vocal or solo feeds, and low-frequency subwoofer effects which may receive special attention during mixing.

The source for the discrete inputs may typically be a subgroup output from the mixing console. However, any line-level signal source can be used. Since it will be mixed into the output channels at unity gain, the signal source should have its own level control (such as the channel or subgroup fader on a console) for mixing.

The discrete subwoofer input features a selectable low-pass filter which corresponds to the crossover filters used for the other outputs. This can be turned on to prevent subwoofer effects from extending above the normal subwoofer range, which would not only sound different but also could cause the subwoofer to be localizable due to the extended frequency range of its output. Or if dramatic impact is more of an issue than seamless imaging, the filter may be left off and the subwoofer input signal will be passed through, with full-range response, to the subwoofer output.

The discrete input signals are mixed with the corresponding Multisonic output channels which are derived from the stereo input signals. This creates seamless soundstaging with combined individual and stereo signal sources. The result is a great-sounding stereo mix for everyone in the audience.

Multisonic™ Control

The M44 and M86 both include the C/S Image Balance control which sets the parameters for the Multisonic Imaging conversion process. This control can be set and left in the center position for general applications, or used for fine-tuning the imaging performance with different sources.

High-Pass and Low-Pass Filters

The Multisonic Imagers include subwoofer crossover filters as well as a subwoofer input and output. Switches are provided to select whether the main left/center/right outputs are high-passed (for 95 Hz to 20 kHz response) or maintained as full-band signals (20 Hz to 20 kHz response).

Left/Center/Right Outputs

The Left, Center, and Right outputs are a mix of the Multisonic Imaging signals derived from the stereo sources, the discrete center input, and the 5.1 left, center, and right inputs. This allows optimum front soundstaging for all types of signal sources, either individually or in combination.

Spreadsound™ Surround (M86 Only)

The M86 includes a Spreadsound™ circuit in the derived-surround signal path. The derived surround signal consists of the left stereo input minus the right stereo input. In almost all stereo recordings, this signal consists of reverberation and other spatial components of the mix. Sounds placed at the center of the sound stage are cancelled out.

Spreadsound is a method of preventing a focused phantom-center sound location by spreading the sound from one loudspeaker to the other loudspeaker, filling in the entire space between them rather than creating a phantom center. When listening to derived surround, a smooth, spread-out, rear-to-sides effect can be achieved.

Spreadsound uses a special phase-shift circuit to create two outputs in relative quadrature phase at all frequencies withing the audio range. This process is applied to the derived surround signal from the stereo inputs, and results in two different outputs which are routed to left and right surround.

Surround Outputs (M86 Only)

The surround outputs on the M86 are a mix of the derived Spreadsound surround signals from the stereo inputs, and the left and right discrete surround signals from the 5.1 input.

The portion of the surround mix from the 5.1 source is controlled by the 5.1 input level control (which also affects the entire 5.1 signal level). The portion of the surround output mix which is the derived Spreadsound signal from the stereo inputs is controlled by the Surround level control on the stereo input side.

The overall level of the surround outputs is controlled with the Surround Output Level control.

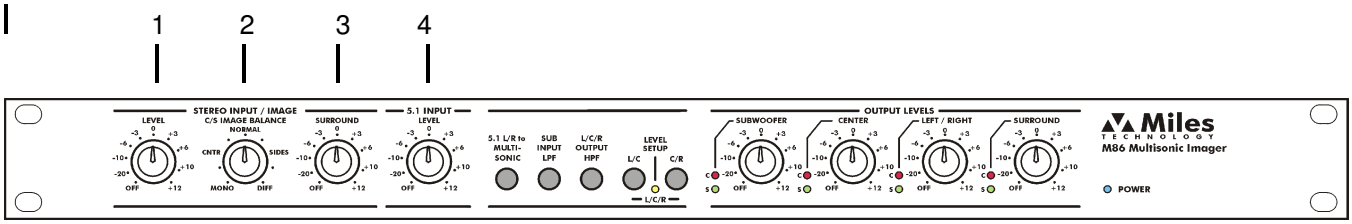

Fig. 3 M86 Front Panel

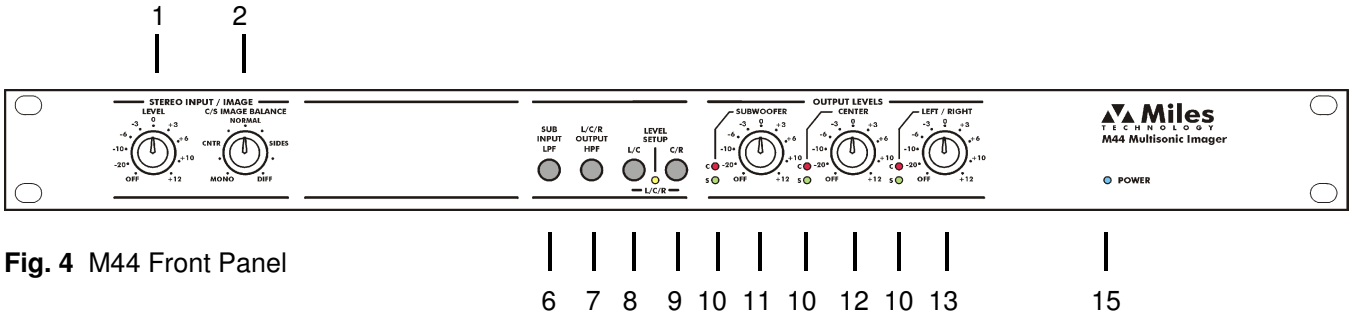

Fig. 4 M44 Front Panel

Control Functions: Front Panel

Refer to **Figure 3 (M86) or 4 (M44)**.

1. Stereo Input LEVEL control: Adjusts the stereo-input gain and overall volume level; can be used to compensate for different incoming signal levels. All outputs levels will be affected simultaneously. The Discrete Center and Sub Inputs are not affected by this; they remain at unity gain. The 5.1 inputs are not affected either except when the '5.1 to Multisonic button' is pressed; then only the left and right inputs from the 5.1 source are also affected by the Stereo Input LEVEL control.

2. Stereo Input C/S IMAGE BALANCE control: This will affect the relative loudness balance of the center and side loudspeakers, and hence the balance of those localized components in the mix. It can be used to focus the sound into a wider or narrower soundstage, or for 'shuffling', or altering the mix, making the center portion louder or softer compared to the left and right sides. It sets the Multisonic matrix parameters which determine the separation and width of the stereo image.

When set to 'Diff', the result will be center (or vocal) cancellation, except for low bass; when set to 'Center', the result will be center (or vocal) enhancement; at the 'Mono' setting, the left and right sum together which yields a maximum-center effect.

3. Stereo Input SURROUND control (M86 only): Adjusts the send level of the derived surround signal for convenient balancing of the derived surround with the front loudspeakers. Once this control is set, the derived-surround signal will track the source level and should not need further adjustment unless the derived surround channels are to be enhanced or attenuated. The signal at the Discrete Surround Input is not affected by this control.

4. 5.1 INPUT LEVEL control (M86 only): This controls the level of the 5.1 input source. The 5.1 input level can be balanced with other signals such as those connected to the left/right inputs, so that when different sources are used, no gain compensation is necessary.

5. 5.1 to MULTISONIC switch (M86 only): When pressed, this routes the left and right channels at the 5.1 input to the Multisonic processor, so that a left-center-right presentation is derived from them. The 5.1 input's center, sub, and surround signals are routed normally.

This function is extremely helpful for 5.1 mixes which lack an effective center signal. It's essential for 5.1-format videos which only provide a stereo or four-channel audio mix.

It's generally useful for 5.1 movies, where typically the dialog is in the center but the music is a simple left-right mix. Note that the Multisonic derived center signal is added to the source's discrete center signal. This provides excellent compatibility with virtually all 5.1 sources.

6. Sub Input LPF switch: A low-pass filter is applied to the discrete subwoofer input signals—both the Discrete Subwoofer XLR input and the 5.1 (RCA) Subwoofer input. This is a fourth-order Linkwitz-Riley crossover filter at 95 Hz. It can be left off to send a full-band effect signal to the

subwoofer. Or, when pressed, the filter prevents the subwoofer from reproducing higher frequency components of its program material.

7. L/C/R Output HPF switch: This applies high-pass filters to the Left, Center, and Right Outputs. The filters are fourth-order Linkwitz-Riley alignments set at 95 Hz. They should be engaged when the main left, center, and right loudspeakers are not intended to reproduce low frequencies in the program material. The filters are designed for proper crossover summing with the subwoofer output signal.

8. L/C Level Setup switch: Press this to listen for matched level of the left and center speakers. This is for use during setup; see page #. It applies the center signal identically to the left and center outputs, while muting the right output. While the L/C Setup switch is pressed, the yellow LED will light.

9. C/R Level Setup switch: Press this to listen for matched level of the center and right speakers. This is for use during setup; see page #. It applies the center signal identically to the right and center outputs, while muting the left output. While the C/R Setup switch is pressed, the yellow LED will light.

10. Output Level Indicators: Each output control has an associated two-light level display which shows the actual output level. The green light indicates the presence of signal above -20 dBu (80 mV). The red light indicates the clipping distortion of the audio signal. The green light should flash with the signal most of the time; the red light should not light—if it does, the input or output level is too high.

11. SUBWOOFER OUTPUT LEVELcontrol: This adjusts the gain of the subwoofer output stage so that its level can be balanced with the rest of the system. This can often be optimally set simply by listening while in the center of the listening area.

12. CENTER OUTPUT LEVELcontrol: This adjusts the gain of the center output stage so that its level can be balanced with the rest of the system. This adjustment is part of the system setup procedure.

13. LEFT/RIGHT OUTPUT LEVEL control: This simultaneously adjusts the gain of the left and right output stages so that the signal level can be balanced with the rest of the system. The left-right balance should be preserved.

14. SURROUND OUTPUT LEVEL control (M86 only): This simultaneously adjusts the gain of the surround output stages so that their levels can be balanced with the rest of the system. Once this is set, the relative balance established with the amplifier gains will be preserved.

15. POWER indicator: Indicates when ac power is applied to the unit.

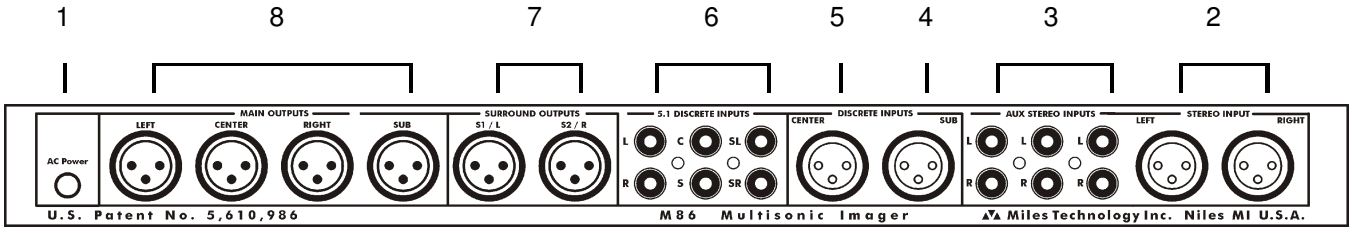

Fig. 5 M86 Back Panel

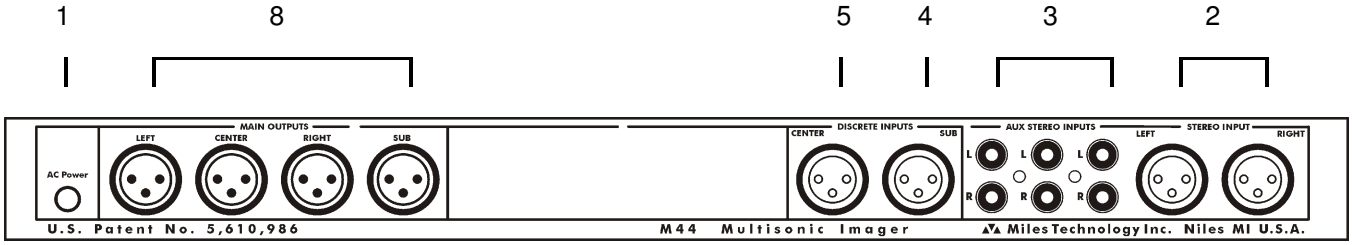

Fig. 6 M44 Back Panel

Control Functions: Back Panel

Refer to **Figure 5** for M86 or **Figure 6** for M44.

1. AC Input Power: This is for connection to the ac power mains. Be sure that the correct voltage is applied, according to the power supply setting you have. The voltage is set to either 120V or 240 Vac with inside jumpers (see page #). The unit may be left on indefinitely or switched with other equipment. When switching the ac power with other equipment be sure that the power amplifiers turn on last.

2. LEFT and RIGHT Balanced Stereo Inputs: Line-level female XLR inputs for connection of the left and right main input signals. These signals will route to all outputs in Multisonic® form. Use this for all two-channel stereo sources (such as CD, stereo instrument, etc) which can be supplied through a line-level XLR connection. This is ideal for balanced sources.

3. AUX STEREO INPUTS: Three line-level RCA/phono stereo input pairs for connection of additional stereo input sources, or any device with consumer-level (-10 dBu) RCA-type connections. These signals will route to all outputs in Multisonic® form.

4. DISCRETE SUB INPUT: For connection of a discrete subwoofer signal from an external source (such as a mixing console channel or subgroup output) which is to be routed directly to the subwoofer in the sound system. This is useful for live-production applications which include sub-bass effects, and it's desired to mix them only into the subwoofer loudspeakers.

5. DISCRETE CENTER INPUT: For connection of a signal from an external source (such as a mixing console channel or subgroup output) which will be routed directly at unity gain, to the Center Output. This signal will not be affected by any front-panel controls except the Center Output Level control. It is intended for driving only the center loudspeaker with the selected signal channel (such as live vocals which remain at center stage). This is primarily for live-production applications.

6. 5.1 DISCRETE INPUTS: Line-level inputs for connection of a 5.1 signal source such as a DVD player with analog outputs, or any other analog 5.1 signal. RCA-type connections are provided for left, right, center, subwoofer, left surround, and right surround.

7. SURROUND OUTPUTS: These balanced outputs provide the corresponding left and right surround signals from the 5.1 input, with an added mix of the Spreadsound signal derived from the left/right stereo input sources.

8. MAIN OUTPUTS: These balanced, symmetrical outputs provide the left, center, right, and subwoofer signals for the front loudspeaker array.

Specifications

Front Panel Controls
Stereo Input/Image:
Level, C/S Image Balance, Surround
5.1 Input:
Level, 5.1-to-Multisonic switch
Discrete Sub Input:
Low-Pass Filter switch
Output Levels:
Subwoofer Level, Center Level, Left/Right Level, Surround Level
Output Switches:
L/C/R Output High-Pass Filter, LC and CR Setup.

Front Panel Indicators
Signal Present (green) and Clip (red) for each of:
Subwoofer, Center, Left/Right, and Surround Outputs
Setup Function (yellow)
Power On (blue)

Inputs
Stereo Left and Right, Discrete Center and Discrete Subwoofer:
XLR connectors; balanced/differential inputs; +22 dBu maximum input level; 22,000 ohms input impedance.

Stereo Left and Right (unbalanced):
Gold RCA phono-type connectors for three stereo input connections; +11 dBu maximum input level, 8,500 ohms input impedance.

5.1 Input (M86 only):
Gold RCA connectors for left, center, right, subwoofer, left surround, and right surround; +11 dBu maximum input level, 8,500 ohms input impedance.

Outputs
Left, Center, Right, and Subwoofer:
XLR connectors; balanced, +26 dBu maximum output into 1200 ohms, 100 ohms differential output impedance.
Left Surround, Right Surround (M86 only):
XLR connectors; balanced, +26 dBu maximum output into 1200 ohms, 100 ohms differential output impedance.

Subwoofer Crossover Filters
Fourth-order Linkwitz-Riley filters.
Crossover Frequency: 95 Hz

Signal Path
Frequency Response, any input to any output (except crossover filter paths):
20 Hz to 20 kHz ±1 dB.
Total Harmonic Distortion:
At max. output: < 0.03%, 20 Hz - 20 kHz.
Typical: 0.005%, 20 Hz - 20 kHz.
Output Noise, 20 Hz to 20 kHz:
< -84 dBu symmetrical, < -90 dBu unsymmetrical.

Power Source
Ac line voltage:
120 or 240 Vac, selectable with internal jumpers.
Power consumption:
10W max.
Grounding:
Grounding ac plug; grounded chassis.

Dimensions
1U rack space.
19" x 1.75" x 10.5"
(48.3 cm x 4.45 cm x 26.7 cm)

Shipping Weight
15 lbs. (6.8 kg)

Note: 0 dBu = 0.775 Vrms

Block Diagram

The block diagram of the M86 is shown in **Figure 7**, and the block diagram for the M44 is shown in **Figure 8**. This shows the internal signal path routing and helps to illustrate its design and signal-processing capabilities for various audio applications.

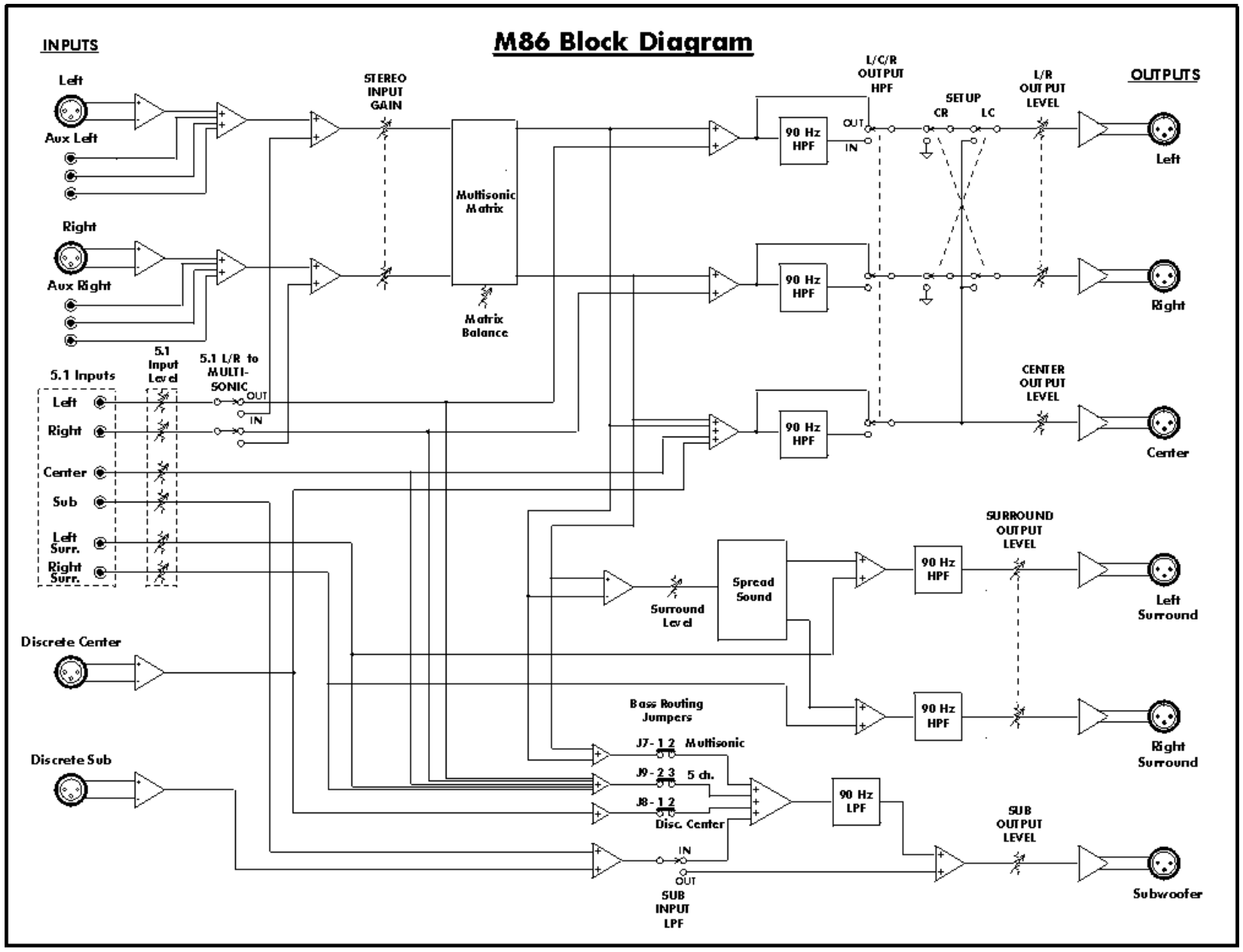

Fig. 7 M86 Internal Block Diagram

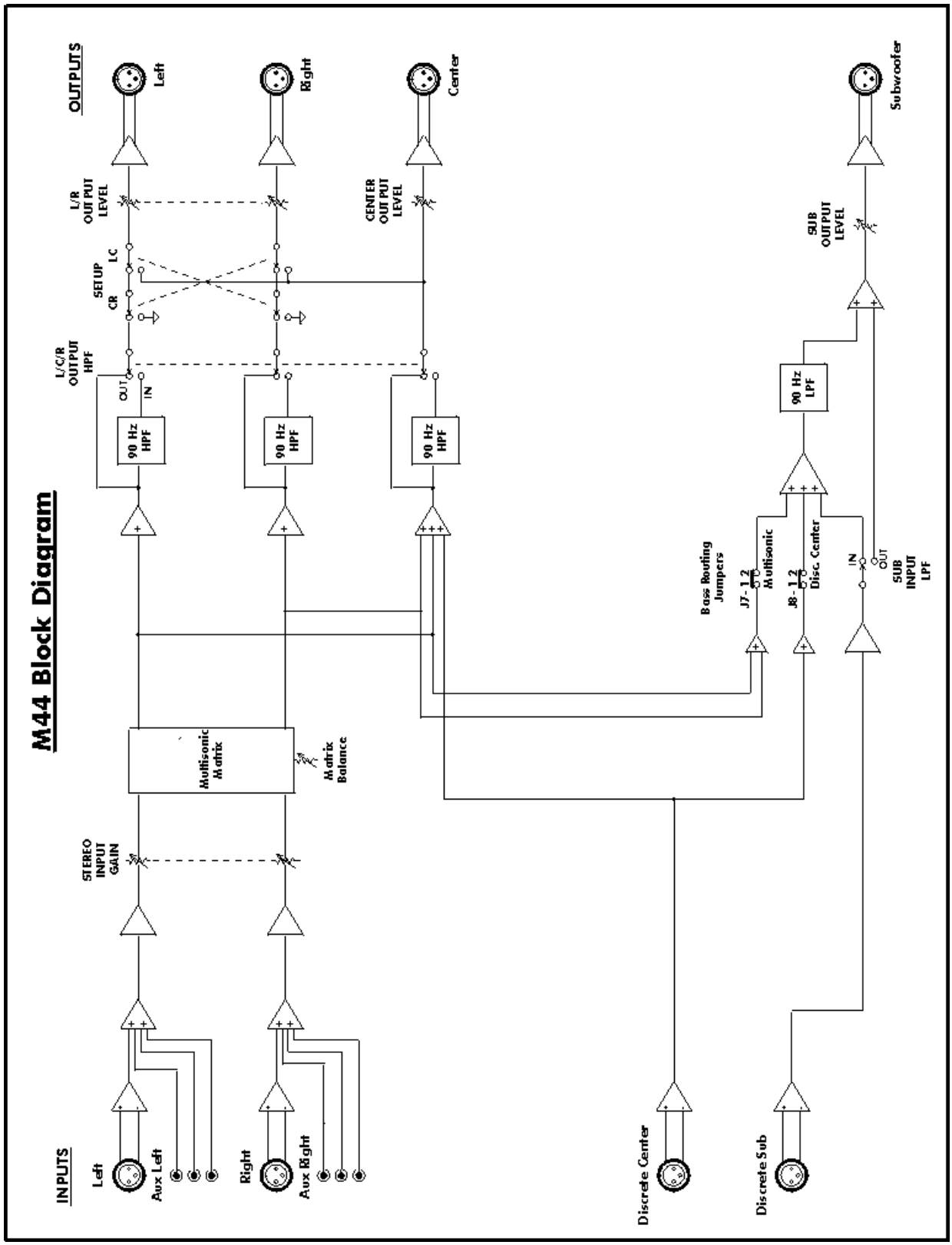

Fig. 8 M44 Internal Block Diagram

3 System Design and Installation

Equipment Selection

The complete design of a multichannel sound system is complex and beyond the scope of this manual; however some basic guidelines are included here to illustrate the differences between multichannel and conventional or stereo systems.

Multisonic Imaging systems are designed much like conventional stereo systems. The addition of a center loudspeaker, carefully integrated with the left and right loudspeakers, is the main difference. With stereo program sources supplied in the usual way, a very effective left-center-right or 5.1 format presentation is created.

The following basic equipment is needed:

1. An M86 or M44 Multisonic® Imager to provide the electronic spatial signal separation. If surround loudspeakers are to be used, then the M86 is needed. The M44 can be used for left-center-right-sub (only) systems.

2. Three loudspeaker systems for the main front soundstage. They should be identical if possible; at least the left and right should be identical—the center should match them if possible but the system will be tolerant of a mismatched center loudspeaker, as described below.

3. For an M86 Multisonic® surround system, surround loudspeakers are needed. These are often distributed around the sides and rear of the listening area. Any number of surround loudspeakers can be driven by the M86. For systems which need directional rear loudspeakers (as sometimes utilized in discrete 5.1 mixes), usually only two are used (left rear and right rear).

4. Subwoofer loudspeaker system(s) if utilized.

5. The appropriate number of power amplifiers to drive all of the loudspeakers. Note: for small systems with identical left, center, and right loudspeakers, a single stereo power amplifier may be utilized to drive all three. See page 21.

6. Any other necessary stereo or multichannel signal processing equipment. See the section discussing Other Signal Processing.

There are many factors affecting the design of a multichannel system. Primary areas of concern are room acoustics, equipment selection, and loudspeaker placement.

Loudspeakers

Of course sound quality is usually the primary concern for loudspeaker selection. In general one ought to use the best-sounding loudspeakers available within the sound-system budget. However another critical parameter, especially for larger venues, is the directivity, or coverage angle of the loudspeakers.

The three main front loudspeaker systems should match each other as closely as possible. The simplest approach which works well in medium or small venues, is to use identical loudspeakers for left, center, and right. However, a basic concept of Multisonic Imaging is that each of the three main loudspeaker systems should cover the entire listening area if possible. While the use of identical left and right loudspeaker systems is usually easily accommodated, in larger systems, or those serving a wide audience, the center loudspeaker may need to be different since it must have a wider coverage angle.

In that case, the center loudspeaker should be equalized to match the left and right loudspeakers as closely as possible, in terms of frequency/phase response. This will allow good phantom imaging between left and center, and between center and right.

Another approach is to use a two-sided loudspeaker cluster for the center, where each side of the cluster is the same as the left and right loudspeakers but only has to cover half of the audience. This ensures that the sound of the center will match the sides.

Power Amplifiers

In general, a power amplifier channel is needed for each loudspeaker system. Of course additional amplifier channels are needed for actively-crossed-over loudspeaker systems.

In most cases three amplification signal paths are needed for the front sound stage, and at least two more are needed for surround operation. A subwoofer system usually can be monophonic, using only as many amplifiers and loudspeakers as are needed for adequate output level and coverage. For moderate levels or small rooms, a six-channel amplifier such as the Miles Technology MPR-450 is a perfect, cost-effective solution. It can drive left, center, right, two surrounds, and a subwoofer channel.

For larger venues or live sound reinforcement, separate amplifiers of the appropriate size should be used. Primary concerns for the amplifiers are good sound quality and enough power to produce the desired sound level with adequate headroom.

External Signal Processing

General Concept

The Multisonic Imaging System is easily implemented with various types of signal processing equipment. The number of channels needed depends on the specific application.

Figure 9 shows a typical signal processing sequence for most applications. Generally, signal processing which is primarily intended to correct or modify the program material should be *ahead* of the M86. Signal processing intended to correct or protect the loudspeaker systems should normally be *after* the M86.

If the discrete center or sub inputs are used, any full-mix processing (such as overall program compression) will need to be immediately *after* the M86.

Equalization

Program equalization, such as one might use to optimize or correct the sound of recorded program material, is normally placed right after the signal-source equipment. This allows the use of standard stereo (two-channel) equalizers for the stereo inputs, or mono equalization for the center and sub discrete input sources. For stereo sources it is important that the two channels of equalization are set to match each other; otherwise imaging distortion will result.

Compression

A compressor may be used to limit the dynamic range of the sound for louder or more consistent operation. To prevent imaging distortion of stereo sources, it is important that the compression uses linked channels so that the gain reduction of both channels always matches.

Loudspeaker Equalization

If the loudspeaker systems need equalization, then an equalizer channel is needed for each

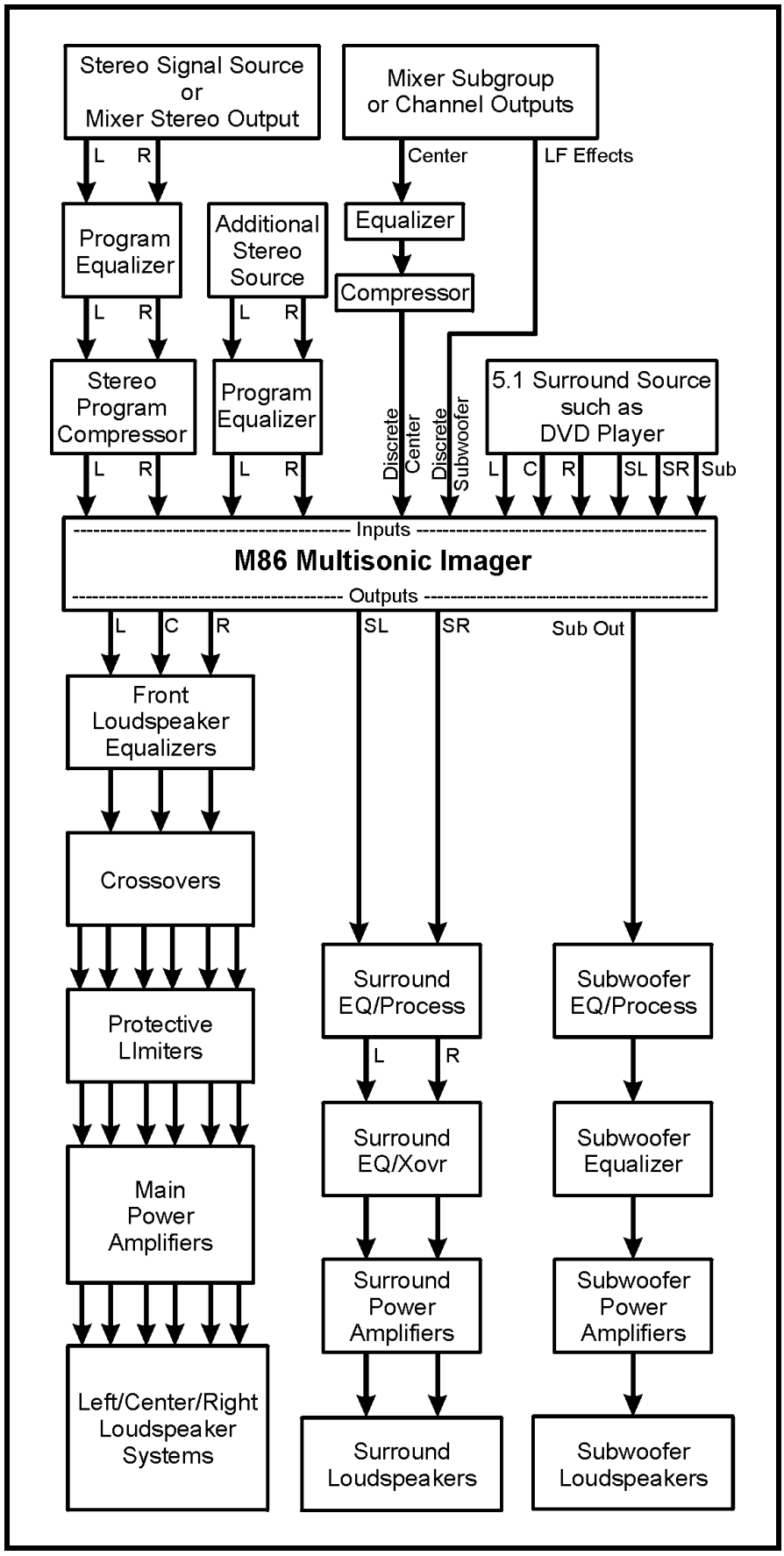

Fig. 9 Typical System Interconnection Sequence.

loudspeaker (after the Imager). Each loudspeaker system can be equalized independently. This is applicable for clusters, multi-way systems, and unmatched center loudspeakers.

However, if only one stereo source is to be used, then a two-channel stereo loudspeaker equalizer may be placed just ahead of the Imager; this way it will correct *all* of the loudspeakers (left, center, right, left surround, right surround, and sub).

Main Crossovers

While an active subwoofer crossover is built into the Imager, larger multiway systems will need external active crossover filters for the higher-frequency crossover points. For multi-way systems, the left, center, and right outputs should go to three crossover systems to drive three amplifier groups. To the extent possible, the three crossover-amplifier-loudspeaker groups should be adjusted to produce matching sonic results.

Protective Limiters

Protective limiting should normally be the last thing before the power amplifiers. This allows adjustment of the other signal processing without upsetting the calibration of the protection thresholds. In addition, special loudspeaker processing or sense-line loudspeaker protection should normally be just ahead of the power amplifiers.

Mono Output

If a mono output signal is needed in addition to the Multisonic outputs, the Center Output can be used for this purpose. It will contain a mono (left-plus-right) mix of the stereo input signals combined with the discrete center input signal. The center output connection can drive multiple line-level devices up to its loading limit.

The center output signal can be used to drive a mono delayed speaker array, for example (see below). If a 5.1 source is used in this application, the “5.1-to-Multisonic” switch should be pressed so that the left and right channels of the 5.1 source will also be mixed into the mono (center) signal.

Multisonic with Delayed Loudspeakers

A popular technique for improving the coverage of a sound reinforcement system is to use additional loudspeakers with delay. These are placed to cover areas at the fringes or rear of the listening area where additional loudness is needed.

These loudspeakers operate with a delayed signal so that they can provide the additional loudness without disrupting the sound staging. The amount of delay is set so that the sound from the main system arrives at the listener just before the delayed sound, usually by about 15 to 30 ms. This helps to retain the sound localization of the main system.

This approach works well with a Multisonic system. There are basically three ways to create the delayed signals—the optimum method depends on the physical configuration of the room. The main front system is set up in the usual way, with left, center, and right loudspeakers. When properly set up and adjusted, Multisonic Imaging localization can generally be retained for those in the delayed coverage areas.

(1) Distributed Mono Delay
This can work well for rooms of virtually any size and shape, and is particularly suitable for very wide rooms, and over or under balconies. Any number of additional loudspeakers are placed such that each covers a part of the rear or extreme-side audience area. The *center output* signal from the M86, which also drives the main center loudspeaker, is delayed and used to drive the additional mono loudspeakers. If necessary multiple delay times are used, and the levels may need to be adjusted separately, depending on the physical setup.

(2) Conventional Stereo Delay
This works for rooms which are longer than they are wide, and a delayed center loudspeaker is not practical. Additional left and right loudspeakers are set up to cover the rear audience area.

In this case, a standard left/right stereo output signal is needed. This can be reconstructed from the M86 outputs in balanced (symmetrical) form by using Left + and Center - for the left output, and Right + and Center - for the right output. This way the left and right will also carry the center-panned information. The reconstructed left/right signal drives the stereo delay system.

Since the delay system is stereo, the two loudspeaker systems should be angled inward so that each covers as much of the rear audience area as possible. This approach can provide a greater sense of space and improved imaging compared to a mono delay system.

(3) Multisonic Delay
This works well for rooms which are longer than they are wide. Additional left, center, and right loudspeakers are set up to cover the rear audience area. The left, center, and right outputs from the M86, which are used for the main system, are also delayed and used to drive additional loudspeakers which are located above the audience to cover the rear audience area.

Room Acoustics

The optimum achievable quality of stereo imaging is very dependent on the room acoustics. Generally, the deader the room, the better the imaging. Live rooms provide their own ambience which can be detrimental to the sound system. Any hard flat surface, of large area, will create sound reflections which can be especially harmful to imaging and overall sound quality. Such surfaces may need acoustic absorption treatment, especially if they are near or opposite the loudspeakers.

Of course very dead (anechoic) rooms are usually not practical, nor even desirable, since they require much more amplifier power to achieve a given sound level. Generally the optimum situation is a room which is fairly dead behind and to the sides of the loudspeakers, while providing diffused sound reflections from the remaining areas.

Loudspeaker Placement

Loudspeaker placement is very important for good imaging performance. While conventional setups are often optimized for maximum audience coverage, good stereo imaging goes beyond that—it is also necessary to optimize the dispersion and the time alignment between the loudspeakers.

In a traditional two-loudspeaker system, the soundstage is automatically created on a line from the left loudspeaker to the right loudspeaker with little expectation of good imaging for off-center listeners. However, the Multisonic Imaging concept is intended to maintain the front-line soundstage, to focus it better, and to allow listeners to be far from center and still hear the stereo image correctly. This can be achieved if the loudspeakers are set up correctly; a bit more care is needed for the best possible imaging performance.

To the extent possible, each of the three front loudspeakers should cover the entire listening area, so that every listener can hear each of them. Large venues may require loudspeaker clusters with appropriate dispersion performance designed to cover the entire audience from each of the three locations.

In medium or small rooms individual loudspeakers can often be used with excellent results. It can be advantageous for the left and right loudspeakers to be aimed somewhat inward so that the opposite side coverage is balanced in level with the same-side coverage. Even if the loudspeakers cannot cover the entire audience, success can still be achieved due to the forgiving nature of Multisonic Imaging. Those who are outside the area covered by one of the loudspeakers will still hear the entire mix, with some degree of sound staging across the loudspeakers which they *can* hear.

General Placement Concept

The basic concept for loudspeaker placement is shown in **Figure 10**. While this shows a typical small-room setup with surround, it can also be proportionally applied to larger rooms. In this case, two types of surround loudspeakers are shown—dipole loudspeakers at the sides, and standard (forward-radiating) loudspeakers at the rear corners. In typical small rooms, either type can be used, or both pairs can be used together with excellent results.

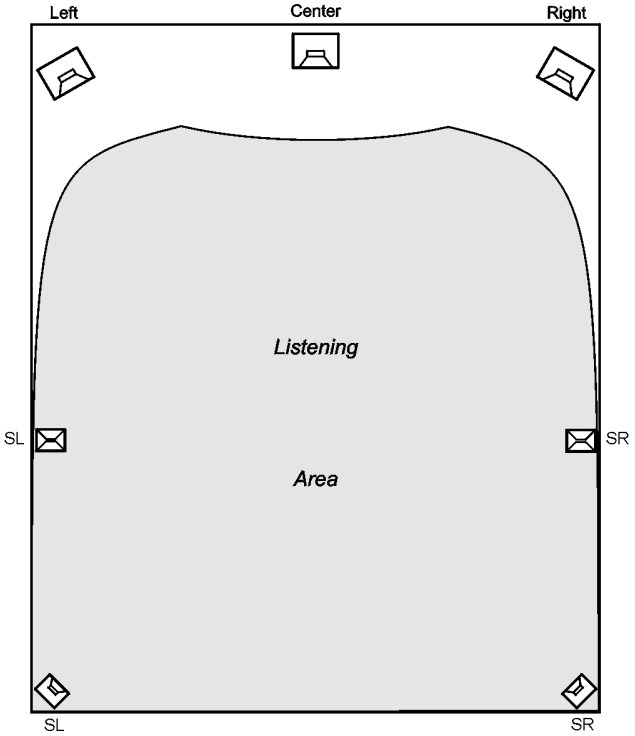

Fig. 10 Loudspeaker placement for Multisonic Imaging with surround.

In a typical small room the front loudspeakers should normally be about three to five feet (1 to 1.6 meters) high; the surround loudspeakers should be higher, near the ceiling. In larger rooms, all the loudspeakers should be high enough to provide even coverage to as much of the listening area as possible.

Figure 11 shows a setup for a larger venue, using clusters for wide coverage. The dashed lines show the left-center and right-center optimum phantom positions. Listeners along these lines will hearperfect phantom imaging of sounds panned to locations between the loudspeakers. The point where they intersect should be toward the back from the center of the listening area. This provides

the maximum listening area with best possible imaging while keeping the center loudspeaker from being too far away. This is a goal; in practice, there is quite a bit of flexibility in the exact placement. If possible, the left and right loudspeakers should about as far apart as the width of the stage or performance area.

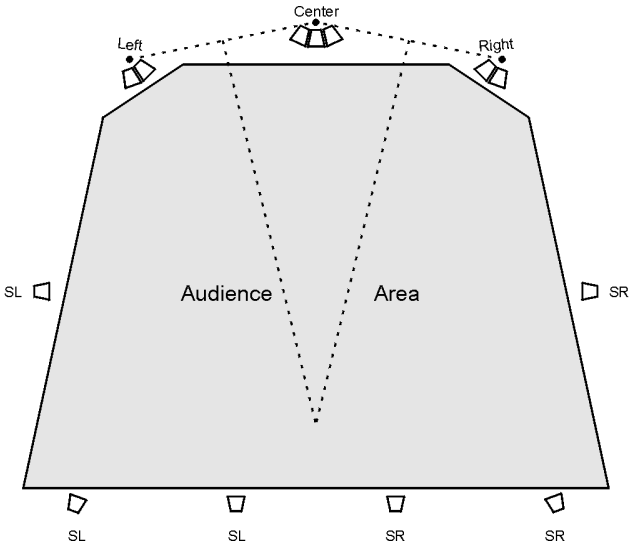

Fig. 11 "Ideal" loudspeaker placement for auditorium.

The surround loudspeakers, if used in this auditorium-type setup, should be high enough above the audience to allow even coverage, but not so high that excess delay or interference problems are created.

Placement Alternatives

The setup shown in **Figure 11** may be impractical due to the design of the auditorium. Often the center loudspeaker needs to be located more in line with the left and right as shown in **Figure 12**. In this case, the center loudspeaker is typically higher than the left and right, which is actually beneficial since the distance from it to the audience area is more uniform. This arrangement can achieve excellent results.

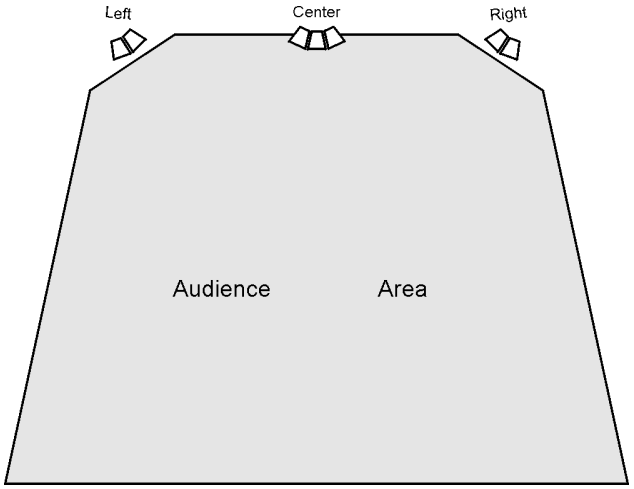

Fig. 12 Loudspeaker placement with the center loudspeaker forward and raised.

Figure 13 shows a more extreme example where a thrust stage requires the center loudspeaker to be placed closer to the central audience than the left and right loudspeakers. Also, the left and right loudspeakers are used largely for the purpose of covering a difficult audience-area shape. In this case the stage configuration and visual aspect of the design need to be accommodated in the sound system layout.

Despite the inability for the side loudspeakers to cover the opposite side of the audience, this arrangement can produce very good results. A large percentage of the listeners in the central audience area can hear excellent stereo sound staging. Those at the sides will hear a shorter sound stage but with a full mix. It is far better than using mono sound.

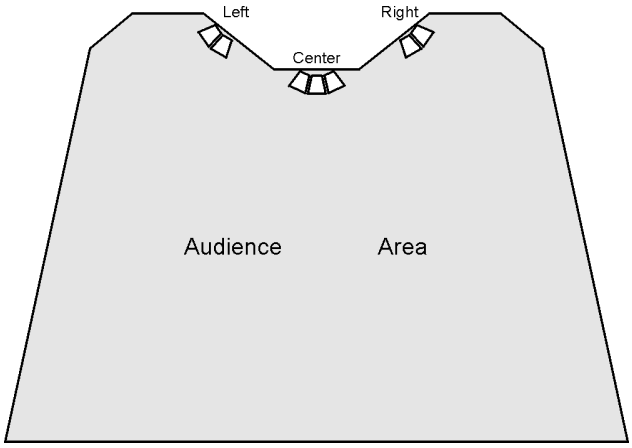

Fig. 13 Cluster placement concept for auditorium.

Left and Right Loudspeakers

The placement of the left and right loudspeakers defines the width of the front sound staging area. Their placement can be determined as it would for a two-loudspeaker stereo system. Generally, the axis of each loudspeaker should be pointed toward the center of the listening area, as shown in **Figures 10** through **12**; this will provide the best overall coverage and frequency response for the maximum-size optimum listening area. When clusters are used, as shown in **Figures 11** and **12**, the inner cluster components, each of which covers the opposite side, can be set to a slightly higher

level to compensate for the increased distance to the listeners.

The Center Loudspeaker

The center loudspeaker should be equidistant from the left and right loudspeakers. Whenever possible, it should also lie on a plane formed by the listener and the left and right loudspeakers. That is, it should be horizontally aligned from the listener's viewpoint, as shown in **Figure 14**.

In many cases, whether due to the stage, a video screen, or architectural requirements, the center loudspeaker needs to be higher than the left and right loudspeakers. This is OK to some extent, and can even be helpful for more even level distribution across the audience. However if it is extreme, the soundstage may be quite noticeably distorted. Still, the result in most cases is effective and very pleasing.

It is usually best to set the center loudspeaker back somewhat, as shown in **Figures 10** and **11**. A good rule of thumb is to place all three loudspeakers equidistant from a point near the rear-center of the listening area, creating a loudspeaker "arc".

To some extent, the signal drive level of the center loudspeaker can compensate for imperfect depth or distance. For example, in **Figure 13**, the center loudspeaker may have its level reduced somewhat. The correct relative level is determined by listening, which is part of the setup procedure. This way, the effect of placement on audible level will be perfectly compensated.

It is generally beneficial for the center loudspeaker to provide wide dispersion. This helps eliminate any on-axis hot spot, while providing uniform coverage for the entire listening area.

Using an Unmatched Center Loudspeaker

In certain installations, it will be desirable or practical for the center loudspeaker to be different from the side loudspeakers. In typical auditorium situations, the center loudspeaker needs to have a wider dispersion angle in order to cover the entire audience area. Architectural considerations often dictate a different type of center loudspeaker. While the theoretical principles of stereo imaging are based upon matched sound sources, good imaging still can be achieved with an unmatched center loudspeaker.

If an unmatched center loudspeaker is used, special consideration of its equalization and gain can improve the imaging capability.
Using a separate equalizer for the center loudspeaker, adjust the equalization so that the overall response and sound quality matches the side loudspeakers. Appropriate test equipment can be helpful for this purpose, but the final evaluation should be done by listening carefully during the setup procedure and then to the results during normal operation.

The center amplifier will very likely need to have a different gain setting from the left and right amplifiers. The setup procedure covers this. For a non-matching center loudspeaker, the bridged-center amplifier connection is not recommended.

Surround Loudspeakers

Surround loudspeakers should be positioned behind and/or to the sides of the listening area, as shown in **Figure 6**. Especially in larger venues, multiple loudspeakers may be used to provide more even coverage. If desired, they can be connected in series, parallel, or series-parallel, to maintain appropriate amplifier loading. They can also be delayed to maintain optimum timing with the main front loudspeakers. In some applications such as small rooms, it can be advantageous to point each surround loudspeaker toward a wall or corner so that the *reflected* sound emanates toward the listening area. The emphasis of reflected sound will be inherent if dipole loudspeakers are used. Unlike the front loudspeakers, a more diffuse sound field is often desirable from the surround loudspeakers.

Multiple Multisonic Imaging

There are many ways to further improve sound staging using multiple Multisonic arrays of loudspeakers. In live surround-sound applications it may be desirable to use a separate Multisonic Imaging array for a rear sound stage. In this case a four-channel mix could be created based on stereo front and stereo rear pairs of channels. This allows specific directionality in the rear system as well as the front. The rear of the listening area is set up with

Fig. 14 Ideal horizontal loudspeaker placement.

a Multisonic array just like the front. Also the sides can be set up the same way for very effective side imaging. An M44 Imager is used for each sound stage array.

System Interconnection

Grounding and Balanced Cable Connections

As with any signal processing equipment, the M86 should have its chassis grounded. Proper chassis grounding will ensure both user safety and maximum RFI protection. This is achieved by plugging the line cord into a grounded outlet.

Pin 1 of each XLR connector is connected to chassis ground to ensure correct cable shield grounding.

Other interconnected equipment should be grounded similarly to limit the common-mode voltages appearing at balanced inputs. If the signal source or load is grounded far away or on a different branch circuit then isolation transformers may be needed.

Here is the connector arrangement on the M44 and M86:

XLR Input or Output Connection
pin 1: chassis ground
pin 2: signal +
pin 3: signal -

RCA Input Connection
tip: signal +
shield: signal -/chassis ground

It's best if all interconnects include complete shield connections. However there is some older audio equipment which allows shield current through pin 1 to inject hum or noise into the system. This could result in a ground loop hum when the shields are connected. A quick solution to this is to use telescoping shields to separate the grounds. In a telescoping shield, each cable's shield is left floating (unconnected) at one end, usually the equipment-output end, while the shield is connected to pin 1 at the other end, usually the equipment-input end. This prevents ground loops through the cable shields. NEVER LIFT THE AC GROUND CONNECTION ON ANY POWER CORD.

Unbalanced Connections

The M44 and M86 XLR inputs can accept either balanced or unbalanced signals. Connect the signal source + to pin 2 and - or ground to pin 3.

The outputs are symmetrical; if a single-ended ("unbalanced") output is needed, use pin 2 for +, pin 1 for ground, and leave pin 3 open. Do not ground pin 3.

Since RCA (phono) connections are single-ended, they are inherently susceptible to adding ground noise to the signal. Therefore RCA cables should be kept short to minimize noise pickup. It is also helpful to use the same ac power circuit for equipment interconnected with RCA connectors.

Basic System Interconnection

The signal interconnections to the M44 or M86 can be arranged as shown in **Figure 9**.

For multi-way loudspeaker systems, each amplifier channel is replaced with an amplifier group preceded with a crossover. All three front (left, center, and right) amplifier channels or groups should have the same output capability.

It is essential to connect all signals with correct polarity. Any polarity problem will be revealed during the setup adjustment procedure and must be corrected.

AC Line Power

The ac line cord includes a safety ground connection. For electrical safety, be certain that the unit is correctly grounded when plugged in.

The M44 or M86 may be left on indefinitely. Only a small amount of power is used.

Be sure the power amplifiers are off before switching the power to other equipment (including the M86) on or off. The powering sequence is important:

In general, when the audio system is turned on, the power amplifiers should be the *last* components of a system to *turn on*.

Conversely, when the audio system is turned off, the power amplifiers should be the *first* components to *turn off*.

The M44 and M86 can easily be set for either 120V or 240V operation. Contact Miles Technology for details.

Bridged Center Connection With One Stereo Power Amplifier

One characteristic of Multisonic Imaging is that the center-loudspeaker signal is always an exact electrical sum of the left and right signals. Therefore it is possible to connect the center loudspeaker in a bridging configuration so that one stereo power amplifier can drive all three front loudspeakers.

This economical approach is useful for systems which will utilize only two-channel stereo (left/right) signal sources. Three loudspeakers (left, center, and right) are driven with a single two-channel amplifier.

A second two-channel amplifier can be used to add a subwoofer and/or surround loudspeakers.

For this application, the front stereo amplifier needs a common output ground (i.e. it is physically bridgeable) and be capable of driving 1/3 the impedance of one loudspeaker. For example, if 8-ohm loudspeakers are being utilized, each channel of the amplifier should be able to drive a load of 2.7 ohms. It is recommended that an amplifier rated at 2 ohms is selected for this application.

The loudspeakers should be identical or at least have the same sensitivity and frequency response. Since the center loudspeaker has no independent gain control or signal path, it should match the left and right loudspeakers for this connection. Thus, correct level balancing will always be ensured. Once the left and right channel gains are matched the center will inherently be perfectly balanced.

The discrete center input can not be used with the bridged-center connection. This connection does not use the center output. Therefore, the Discrete Center and 5.1 center inputs cannot be routed appropriately.

For multi-way systems, the stereo amplifier can be replaced with a crossover and stereo-amplifier group.

The bridged-center connection diagram is shown in **Figure 15**. All connections must have the specified polarity. Any polarity problem will be revealed during the setup adjustment procedure and must be corrected.

The center-loudspeaker positive lead is connected to the *left positive* (“+”) amplifier output, and the center-loudspeaker negative lead is connected to the *right positive* amplifier output, as shown in **Figure 15**. The M44 or M86 Center output is not used.

The stereo input connections are made in the normal way. The subwoofer output and surround outputs may also be used in the normal way, as shown in **Figure 9**.

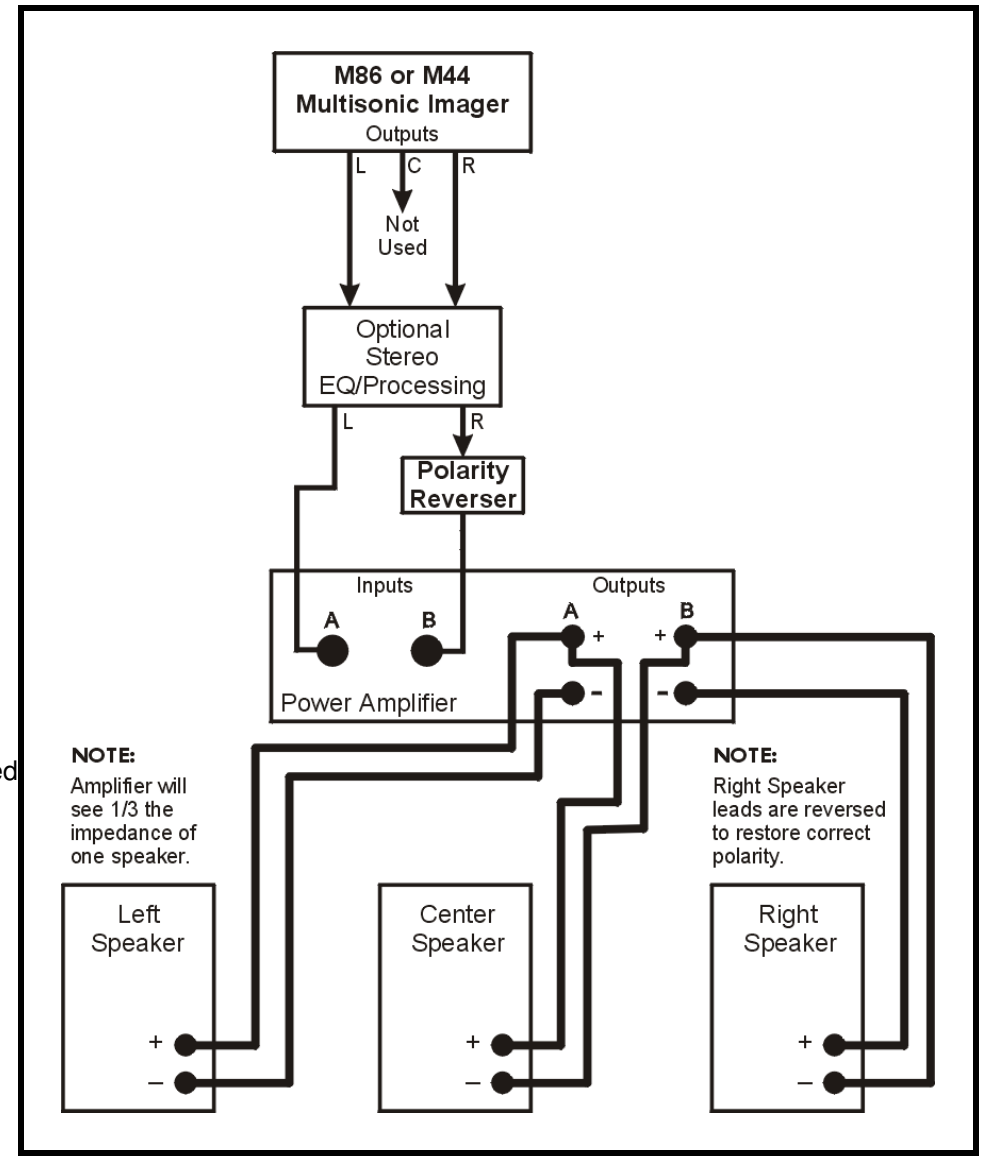

Fig. 15 M86 or M44 Connections with Bridged Center Loudspeaker.

Setup Adjustment Procedure

This setup adjustment will produce correct level balance of all of the loudspeakers so that Multisonic Imaging operates perfectly. Typically the levels are set using the amplifier gain controls, while the Imager's output controls are straight up.

Although the description here is quite detailed, this procedure is really very simple, and often can be done in just a few minutes.

Gain Structure

It is important to have correct system gain structure for the particular equipment in use. If the operating signal level is too low, the system noise level will be higher. If the operating signal level is too high, then distortion and inadequate power can result.

The M44 and M86 Imagers are designed to operate at line level. Its outputs will clip at over 15 volts rms, and the dynamic range is over 110 dB. In order to make maximum use of its available dynamic range, the M86 is operated with a nominal output level of about 1 to 2 volts rms, yielding approximately 20 dB of internal headroom. The necessary headroom is dependent on the type of program material and may need to be increased if compression or limiting is used in the signal path after the Imager.

Most power amplifiers have a maximum gain which is too high, causing the amplifier to clip with an input signal of only 1 or 2 volts. In that case the level controls need to be reduced to allow the optimum input signal level to the amplifier.

A power-amplifier sensitivity (the level which produces full output) in the range of +8 dBu (2 Volts rms) to +18 dBu (6 Volts rms) is recommended. If more system gain is needed, then increase the drive level from the signal source, or for stereo sources use the Source Gain control on the Imager.

If signal processing is used between the Imager and the amplifier, such as crossovers, compressors, or equalizers, then depending on their signal handling capabilities it may be necessary to increase the amplifier gain (and sensitivity) to lower the signal level through these devices.

The exact gain of each power amplifier is adjusted as described in the following section.

A. Setup Adjustment of Front Amplifier Gains

For optimum Multisonic Imaging performance, it is important to have each power amplifier gain set for audibly matched loudspeaker output. This is easily accomplished using the Setup switch on the M44 or M86. Here is the basic procedure:

1. Set the center amplifier gain at an appropriate level. As mentioned above, a sensitivity in the range of +8 dBu to +18 dBu is recommended. For most amplifiers this means turning down the gain control. Usually somewhere near the middle of the control range is about right. Set the left, center, and right amplifier gain controls at the same position.

2. Press in the LC Setup switch on the M44/M86.

3. Play some program material through the system. Listen at a location slightly behind the center of the listening area (where the long dashed lines intersect in **Figure 11**). You should hear the sound coming from a point exactly midway between the left and center loudspeakers.

4. If the sound is closer to the center loudspeaker, then turn up the left amplifier gain. If the sound is closer to the left loudspeaker, then turn down the left amplifier gain. Precisely adjust the left amplifier gain so that the sound is exactly as described in step 3.

5. Press out the LC Setup switch and press in the CR Setup switch on the M44/M86.

6. With program material playing through the system, listen again at the same location slightly behind the center of the listening area. You should hear the sound coming from a point exactly midway between the center and right loudspeakers.

7. If the sound is closer to the center loudspeaker, then turn up the right amplifier gain. If the sound is closer to the right loudspeaker, then turn down the right amplifier gain. Adjust the right amplifier gain so that the sound is as described in step 6.

8. Press out the CR Setup switch to return to normal operation. Adjustment is now complete.

B. Setting Amplifier Gains With Bridged Center Loudspeaker

When the bridged-center-loudspeaker connection is used, the two amplifier channel gains should match. Here is one method to achieve precise matching:

1. Set the amplifier gains close to the desired level.

2. Press in both the LC and the CR Setup switches.

3. Disconnect the center loudspeaker.

4. Play some program material and listen from a location on the centerline equidistant from the left and right loudspekaers and near the center of the audience or listening area.

5. Carefully adjust the left or right amplifier gain, if necessary, so that the sound creates a phantom image at the location of the center loudspeaker. It

should sound like the center loudspeaker is actually on, even though it's disconnected.
6. Reconnect the center loudspeaker and return the LC and CR Setup switches to the out position.

7. Correct system connection and operation can be verified using the LC and CR Setup switches independently as described in sections A1-A8 above.

Setup Adjustment of the Surround Level

With the M86 Surround Output level control and the Stereo Input Surround level control at the center position, the surround amplifier gain controls are adjusted for normal operating level. This way, if further adustment is made on the M86 (such as for a particular program source), then it is easy to return the surround system to the preset level.

The 'correct' level for the surround loudspeakers is somewhat subjective and arbitrary. The surround amplifier gain controls are used to set the surround level while listening to the system with appropriate program material. If a 5.1 source (such as DVD player) will be used then a 'typical' DVD, preferably a music DVD (where the surround level is usually more critical) should be used as a program source.

The center of the listening area is usually the best place to listen when adjusting the surround level. While it is actually a matter of preference, a popular level for the surround channels with music program material is such that the surround sound field is barely audible compared to the front channels. For movies, the surround loudspeakers can be higher so that during surround effects, their level is comparable to the front. Be sure to balance the left and right surround levels when adjusting the amplifiers.

If 5.1 sources are rarely or not used then the amplifiers should be adjusted using a left/right stereo program source.

One way of adjusting this precisely is by setting the C/S Image Balance control fully clockwise to "Diff". Then, using 'typical' stereo program material, adjust the surround amplifier gains so that the surround loudspeakers are balanced at the same level with the front left and right loudspeakers. Listening at the center of the listening area, a well-balanced surround effect should be heard with the surround signal heard evenly from all directions. Then return the C/S Image Balance control to its center position, and the resulting surround level should be correct.

To adjust for individual program variations, the Surround Output level control is used for 5.1 sources. Either the Surround Output level control or the Stereo Input Surround level control can be used to adjust the derived surround from a left/right stereo source.

4 Multisonic Imager Operation

Control Adjustments

Input Level Control Operation

The Stereo Input Level control on the M44 or M86 affects the overall gain of the stereo input signals to all of the outputs. On the M86 it will also affect the left and right inputs from the 5.1 source only when the '5.1-to-Multisonic' switch is pressed. It does not affect signals at the Discrete Center and Discrete Subwoofer inputs.

This control can be used as an overall volume control for the stereo input sources.

With the control at midpoint, the unit will operate just a little (about 2 dB) over unity gain but there is an additional 6 dB gain due to the outputs being symmetrical (balanced) which provides an extra 6 dB of gain and headroom. In most applications, the straight-up position or higher is optimum. A lower position is ok when full power is not expected or when the power amplifiers (or other subsequent equipment) have higher gain than needed.

C/S Image Balance Control Operation

The C/S Image Balance control sets the parameters used in the Multisonic Dispersion Matrix circuit. It will effectively control the "width" of the mix. The program material must be a stereo mix, or have SpreadSound applied, to be able to adjust this.

One option in setting this control, for a recorded or pre-mixed signal source, is to adjust it so that all three loudspeakers have the same loudness. To do this, it usually helps to be a bit off-center in the listening area. Simply adjust the C/S Image Balance control until the center and side loudspeakers seem to have the same output level. Under this condition, you will have the maximum possible separation and optimum Multisonic dispersion for that program source.

Another method is to listen carefully to the mix and adjust the control for a good level balance between the prominent, central parts of the mix (such as lead vocals, if present and centered) and the side or ambient parts of the mix. If the central portion of the program material is either too dominant or too weak, this control can be used to compensate and correct it. Recordings vary in the way they are mixed, and for the most critical and optimum results, the C/S Image Balance control can be used to optimize for each recording.

Many recordings are recorded with a somewhat-narrow sound stage. This studio mixing approach provides more consistency for monophonic reproduction. By setting the C/S Image Balance control toward "sides", perhaps at the 1 o∗clock or 2 o∗clock position, a full-width perspective can be restored without sacrificing image clarity.

Some recordings are recorded with a wide image, or they may seem to have a weak central area. Older or poorer-quality stereo recordings, especially if they are on cassette tape, may have a weak center due to poor phase accuracy between the left and right channels. Also, certain recording techniques (such as stereo synthesis) or mike setups (such as a wide-spaced pair) can cause a weak center. In any of these situations, the center can be restored by setting the C/S Image Balance control more toward “center” to refocus the central area.

The low-bass level is not affected by the image process. Signals below 80 Hz are focused toward the center for consistent balance. Signals above 80 Hz are imaged to the three loudspeakers according to the way they are recorded. Sound localization is generally not perceivable by humans below approximately 80 Hz.

In many installations, it is not desirable or practical to make adjustments for particular recordings. This is not a problem. The control can be left in the straight-up position or adjusted for good balance, according to the room and sound system, and left there. Every program source will be imaged exactly as it was recorded.

When mixing live, the C/S Image Balance control will change the panning range at the console. To provide normal left-to-right panning, set the control at midpoint.

Surround Control Operation

The Surround control adjusts the level of the surround signal derived from the stereo input signal. The Discrete Surround input signal is not affected by this control.

The Surround level control should normally be adjusted so that the surround outputs provide a sense of ambience without being distracting. If the level is too low, you will not hear much surround signal. If the level is too high, then front left and right signals will be heard in the surround loudspeakers which may be distracting to the front stereo image.

As described earlier, another way to adjust the surround level is to set the C/S Image Balance control fully clockwise (to "Diff") and then adjust the surround level so that a surround effect is realized which is balanced from front to back. A stereo program source is necessary for this. From the center of the listening area, the left, right, and surround loudspeakers should all sound at about the same level. After the desired surround level is achieved, set the C/S Image Balance control back to the Normal (center) position.

If many listeners are located very near the surround loudspeakers, then it may be desirable to move closer to the surround loudspeakers when adjusting their level. The surround level can∗t be perfect everywhere unless a true distributed system with many loudspeakers is used. It helps if the surround loudspeakers are placed high above the listeners. Generally, the surround level can be set once and no readjustment is necessary. The loudness of the surround loudspeakers will be dependent on the surround mix level in the program source.

Adjustment of the C/S Image Balance control for optimum front sound staging with a particular recording simultaneously sets the surround output to its optimum level.

If the C/S Image Balance control is used to widen the image, the relative level of the surround output will increase since there will be a larger difference component. If the C/S Image Balance control is used to narrow the image, the surround level will propor-tionally decrease, since there will then be a smaller difference component. When the C/S Image Balance is optimally adjusted, the surround loudspeakers will usually produce sound at the desired preset level.

Multisonic Mixing

Mixing Live With Multisonic Imaging

Mixing live in stereo with a Multisonic Imaging System is easier than with a conventional stereo P.A. system. Sound can be panned to any location desired, without concern for the audience being able to fully hear everything. As a sound is panned further to the left or right, the same signal begins to emerge in the opposite side, ensuring total coverage of the extreme front and side audience areas.

For example, if an instrument is panned fully to the left, it will also come from the right loudspeaker, at a level 6 dB lower. It will also be inverted—this is part of the imaging process—but listeners very close to the right loudspeaker and far from the left loudspeaker will not notice the inversion. They will hear it at a lower level from the right loudspeaker and that instrument will sound farther away, as it should, since it is on the left.

Normally the C/S Image Balance control is left centered. However it can be used to change the pan control range available at each input of the mixing console.

When set slightly toward Center, it will limit the pan control range to a narrower soundstage. This may be useful when the left and right loudspeakers cover most of the audience and *stereo soundstaging* at the fringe areas is a priority.

If the C/S Image Balance control is set slightly toward Sides, it will extend the pan control range. This may be useful when wide soundstaging for central listeners is desired, and *basic sound coverage* of the fringe areas is a priority. Note that in this case the pan control can still be kept near the center for sounds which require narrower staging.

The Discrete Center and Discrete Subwoofer inputs are typically used with direct or subgroup outputs from the mixing console. This can provide an extra degree of pinpoint focus and high intelligibility for center signals for use where appropriate. The subwoofer input is useful for special effects where a direct feed to the subwoofer loudspeakers is desired.

Sound source panning and mix adjustments are made at the mixing console in the normal way. As always, the best way to determine the optimum pan locations and mix levels is by listening. If the mix location is not too far from the center of the listening area and within the coverage area of all three loudspeakers, everyone in the audience will hear much more closely the same mix that the mix engineer hears, compared to other types of sound systems.

Mixing for Two-Channel Transmission or Recordings

More precise monitoring of a stereo mix is possible using a Multisonic monitor system, even while generating a stereo mix. In this case the resulting stereo output is the signal connected to the input of the Multisonic Imager. The Imager is used just for monitoring.

When mixing for stereo broadcast or for a two-channel recording while monitoring in Multisonic, it is important to leave the C/S Image Balance control in the center 'Normal' position so that the stereo mix will have the same mix balance on a traditional two-loudspeaker playback system.

It is good to listen to familiar two-channel stereo mixes on the Multisonic monitor system so that the differences can be appreciated.

Vocal Cancellation

The M86 can easily and accurately perform vocal cancellation (removal from the mix) in stereo recordings. This process is based on the principle that a lead vocal signal in a stereo recording is almost always panned to the exact center. This also works with other instruments, generally solo instruments, which are panned to the center of the recording.

The procedure is simple: use the left/right stereo inputs and the Surround outputs. Adjust the left-right balance at the signal source so that the vocal signal is minimized. With a high-quality signal source, and most recordings, the vocal or center-panned instrument will be almost completely removed from the output.

An advantage of this method is that the left and right Surround outputs will provide a stereo SpreadSound signal. This signal can be recorded in stereo, preserving the SpreadSound effect for future playback. The stereo SpreadSound signal will have mono compatibility as well.

Another method which can be used on the M44 is to set the C/S Image Balance control to 'Diff' and use the Left or Right main output (they will be the same but one inverted from the other).

Again, adjust the left-right balance at the signal source so that the vocal signal is minimized. This will provide the best possible cancellation.

5 Troubleshooting Guide

System Problems

No output

Check if the Power indicator is on. If not, check the power supply connection and make sure the ac outlet is on. If the Power indicator *is* on, then check the Level controls and all input and output connections. If everything seems to be in order, and there is certainly an input signal, but there is still no output, call customer service.

One loudspeaker channel is not functioning

Press both Setup switches to provide an equal signal to all main (left/center/right) outputs. If this seems to solve the problem (all outputs are now equal), then verify that both left and right input signals exist and are at the desired level. If not, check that the power amplifier is operating and all the output cable connections are correct. Check all the control settings of all equipment in the signal path after the Imager.

The system is noisy

Turn down the Input Level controls on the M86. Does the noise go away? If not, the power amplifier gain is probably too high. If the noise does go away with the Input Level down, the noise is in the program source. Be sure the gain structure is correct throughout the system.

Noise in the surround channels

As above, check the gain structure, and make sure there is not too much amplifier gain. Does the noise goes away when the Surround Output Level control is turned down? If so, then the program source is probably noisy.

Also be sure you have a stereo source; there will be no surround signal with a mono source.

Hum or buzz in the system

Turning down gain controls while going backwards in the signal path is a quick way to localize the source of hum. Start with the power amplifier and go back in the signal path until turning down an input or output gain control does not eliminate the hum. If there is no gain control then instead disconnect the input connection from each piece of equipment. When disconnecting the input, or turning down the input or output does not eliminate the hum, the source of the problem is at that or the following piece of equipment.

Hum or buzz is usually caused by a ground loop from the use of an unbalanced connection or a piece of equipment with a “pin 1 problem”. In either situation, shield current noise (which is usually hum or buzz) is added into the audio signal. Be sure that all equipment is correctly grounded. If both the Imager and the other equipment have their chassis grounds connected to the ac-line safety ground, then pin 1 at an XLR connection may be lifted (i.e. opened, or not connected) at one end of the cable. This should be done at the cable which when disconnected causes the hum to stop. This will remove the shield current from the signal connection.

Another possible cause of hum is a very strong magnetic field near the Imager or other signal-processing equipment. For example, this could happen if any line-level equipment is very

near a power amplifier or any big power transformer. Try increasing the distance to any nearby power equipment.

Sometimes RFI can induce hum in the system. This could result from a nearby transmitter or a lamp dimmer on the ac line. If proper grounding technique does not solve this, then an RF filter for the ac line (such as Radio Shack 15-1111 for moderate suppression) might be helpful.

Radio frequency interference

Be sure all equipment has its chassis properly grounded to earth ground. All cables except loudspeaker cables should be shielded with the shields terminated at a chassis ground point.

For line-conducted noise, an ac line filter (such as the Radio Shack 15-1111) may be useful. This may be relevant if the RFI source is known to be other equipment used on the same power line.

RFI is often picked up from strong fields radiated nearby. If connections and cables are optimized for grounding and shielding, and there is still interference, it can often be solved by connecting 0.01 uF ceramic capacitors from each input and/or output signal connection to chassis ground. Bridging balanced signals with a capacitor from + to S may be helpful also.

Imaging

Lost sound; center is weak or missing

Check that the center loudspeaker is correctly connected. The polarity of all signals must be correct. Use the setup procedure to verify correct left-center and right-center phantom imaging, as well as optimum amplifier gain settings.

If using a bridging connection, check for a polarity problem.

With C/S Image Balance set to Mono (full counterclockwise), the center loudspeaker should be 6 dB louder than the side loudspeakers. It should contain a strong center signal; if it doesn't, then check the input signal polarity.

Sometimes the program source may have one channel inverted which will cause this problem even though the imager and loudspeaker systems are working correctly.

If the program source has poor correlation or extreme phase shift between the left and right channels (common with inexpensive cassette tape decks for example) this can cause a weak center channel. The solution is to compensate by moving the C/S Image Balance toward Center.

Check the loudspeaker placement. The center loudspeaker should not be set too far back relative to the side loudspeakers.

Center is too loud

Check the amplifier gains and verify their correct setting with the setup procedure.

Make sure the program source is stereo. Set the C/S Image Balance to Diff; you should hear a strong difference signal. If the sound mostly goes away, then the program source is probably mono, in which case the center *should* be louder.

Balance is off; sound is lopsided

Check the program source for channel balance. This symptom is usually caused by an unbalance in the source. Compare with Mono source material. Make sure the amplifier gains are set correctly with the setup procedure.

Won't image left or right

Verify the polarities of the loudspeakers. This is done with the setup procedure. You should be able to hear solid phantom imaging at left-center and right-center.

There may be a problem with the signal source. Try different program material, and make sure it has good left-right balance.

Also check the loudspeaker placement. Try pointing the left and right loudspeakers inward more for improved coverage of the listening area.

Won't image between the loudspeakers

Check the setup and placement of the loudspeakers as described previously.

Best in-between imaging performance requires good matching between the loudspeakers and smooth, wide dispersion. Optimize the loudspeaker placement for even coverage. If the center loudspeaker does not match, it will be helpful to use an equalizer for the center channel; adjust it for the best possible frequency response match with the side loudspeakers.

Can't hear loudspeakers on opposite side from listener

This can be caused by poor loudspeaker placement or inadequate dispersion (coverage) of the side loudspeakers. Try angling the side loudspeakers inward more for better coverage of the opposite side.

Surround sound is weak or missing

Be sure you have a stereo source; there will be no surround signal with a mono source.

A source signal with low separation will have a weak surround component. This can be solved by setting the C/S Image Balance control toward Sides. Or, simply increase the setting of the Surround control.

Left or Right signals come from the surround loudspeakers

To some extent this is normal. If it is distracting then the surround level may be too high or the C/S Image Balance is set too wide.

To verify the distinction of left or right from surround, with a given C/S Image Balance and Surround level setting, turn off or disconnect one channel, e.g. left connection only, of the input signal. The surround loudspeakers should be audible, but the right loudspeaker should dominate throughout most of the listening area. The same is true for the left loudspeaker with the right input disconnected. If the surround loudspeakers compete or dominate the localization, then the overall surround level should be turned down.

Sound Quality

Weak bass

Verify correct polarities of all loudspeaker connections.

If an external active crossover is used, make sure it is set up correctly. If the low bass is to be summed to mono, use only the center output of the Imager. This will be very effective for crossover frequencies around 100 Hz or lower.

Weak dialog

This problem sometimes occurs with surround-sound movies, and in general it is due either to a poor mix or excessive dynamic range. It can be partially solved by setting the C/S Image Balance control toward Center.

Center is not clear

If the program source has poor correlation or excessive phase shift between the left and right channels (common with inexpensive cassette tape decks for example) this can cause a weak or blurry center signal. The solution is to compensate by moving the C/S Image Balance toward Center.

Tunnel effect

This can be caused by phase problems with the signal source. If the center is also weak, setting the C/S Image Balance toward Center may help.

If the center is strong but still sounds like a tunnel effect, then it is a part of the program source, probably caused by intense signal processing. Multisonic Imaging will reproduce this effect exactly.

6 Product Support

Warranty

All Miles Technology products are warranted against malfunction due to materials or workmanship for a period of three years beginning at the date of original purchase. If such a malfunction occurs during the three-year period, the product will be repaired or replaced, at the option of Miles Technology, without charge. If delivered to Miles Technology postage-paid and with authorization, the unit will be returned with postage paid. This warranty does not extend to finish, appearance items, or malfunction due to abuse or ac power at other than the specified conditions, nor does it extend to incidental or consequential damages. The above exclusions may not apply to you. Repair by other than Miles Technology will void this warranty. In the event of a warranty claim, call for return information and authorization.

Customer Service

If warranty service, repairs, or specific product-related technical information is needed, call us at **1-800-280-8572**.

More Information

Miles Technology has available a range of application notes and other product-related technical information. To receive more information, visit our web site at www.milestech.com, email us at info@milestech.com, or call us at 1-800-280-8572.