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MX200i CCEP™

ELECTRONIC SIGNAL PROCESSING UNIT
MANUAL
VERSION 1.0

EAW
EASTERN ACOUSTIC WORKS

User Operating Manual

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OPERATING MANUAL
VERSION 1.0

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Introduction

The MX200i CCEP™ is a two channel, two-way electronic crossover designed for use in both fixed installations and touring sound reinforcement. As a Closely Coupled Electronic Processor™, the MX200i is factory configured for use with specific EAW loudspeaker systems. This removes the burden of "setting up" from the end user and ensures optimum system performance under all conditions. The MX200i is compact, robust and very reliable, yet simple to service should the need arise.

Features Overview

The MX200i incorporates a unique combination of features and design innovations that set it apart from conventional crossover networks. Specific benefits are outlined below.

Overload Protection

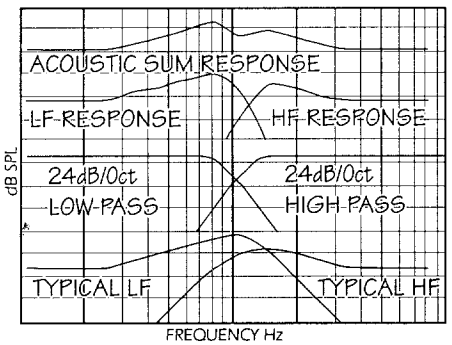
Each frequency band has its own overload protection circuitry. A true-RMS above threshold infinite compressor momentarily reduces gain whenever the preset output limit is approached. This is normally set to prevent the power amplifiers from being driven into clipping, but may also be intentionally set lower to protect particularly delicate drivers or to limit the maximum long term output of the system.

Dynamic Bass Control

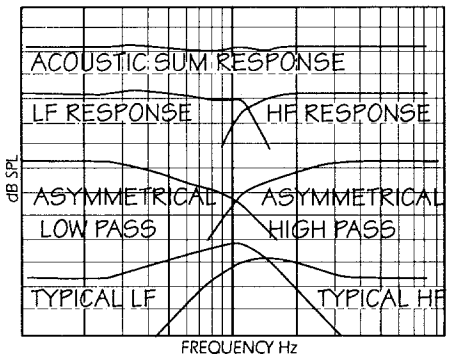
The MX200i's low frequency output incorporates a low frequency excursion control circuit that provides both stepdown alignment equalization and high pass filtering to prevent operation below system cutoff. This filter is equalized to provide maximally extended low frequency response and is controlled at high power output levels to maintain freedom from distortion. This circuit tracks the master threshold control: Its relative threshold is pre-set at the factory.

Phase Compensation

Each MX200i configuration incorporates phase correction circuitry, tailored to the specific systems for which it is designed. This technique compensates for the phase response of the drivers and their relative placement in the enclosure to present the listener with accurate, phase coherent sound. At the crossover points of any multi-way system, the sum of the upper and lower output bands should be flat: This state of affairs occurs only when the two signals being summed are in phase with each other. The amplitude responses of the filter and loudspeaker may each be correct. But when they are combined, phase errors can easily be introduced, so that the overall response is not flat. Definition and intelligibility are lost. Attempts to correct crossover-related phase errors through equalization may disguise the problem, but cannot cure it. The result may produce acceptable measurements with low resolution test equipment such as 1/3 octave analyzers. More detailed measurements as well as simple listening tests confirm that attempts to compensate for phase errors with equalization produce an inconsistent system with audible irregularities.



TYPICAL RESPONSE WITH SYMMETRICAL FILTERS



TYPICAL RESPONSE WITH ASYMMETRICAL FILTERS

Asymmetrical FIlters

The MX200i CCEP™ incorporates independent internal settings for each of the six filters on each channel. Within each filter's individual settings, both pairs of second order filters used to create the fourth order ultimate slope are independently adjustable. This is a key element in the close coupling of the crossover to a particular speaker system, to compensate for acoustical response of individual elements. The graphic representations on this page illustrate the different effects of conventional and asymmetrical filter designs.

Technical Description

Power Supply

The MX200i CCEP™ has a universal power supply that is compatible with virtually any AC power source in use throughout the world today. The power supply design is shielded to minimize the effect of magnetic interference on other equipment and effectively eliminate supply-induced hum pickup. The high current capability of the power supply permits the MX200i to reliably produce the high output levels required to drive multiple professional amplifiers.

Enclosure

The heavy gauge steel chassis of the MX200i is designed to ensure reliable operation even under the repeated abuse sometimes encountered in portable applications. To further ensure reliability, the power transformer is bolted directly to the chassis and all circuitry is mounted on glass fiber printed circuit boards interconnected with computer grade ribbon cables.

Power Connection

AC power is supplied to the unit via an IEC 230 connector on the rear panel of the unit. A two position voltage selector switch, giving a choice of 115V and 230V operation at either 50 or 60Hz, is located directly to the left of the connector. The operating voltage setting is indicated on this switch. With the unit switched in the 115V position the unit should be connected to a 90 to 135 VAC, 50 to 60 Hz source. When the unit is switched in the 230V position the unit should be connected to a 195 to 270 VAC, 50 to 60 Hz source.

WARNING: Make sure that the voltage setting is correct before first powering up the unit. A setting lower than the AC supply may cause damage to the unit.

Directly below the power connector is a fuse holder for a 5 mm x 20 mm fuse. The fuse holder accommodates two fuses: The innermost receptacle is the active fuse and the outer fuse is a spare. It is always important to use the proper fuse for the voltage selected. These values are as follows:
For 115V Operation 0.5A GMA
For 230V Operation 0.25A GMA

WARNING: All units are supplied with a 0.5A GMA fuse intended for 115 VAC operation. Be sure to replace the fuse with a 0.25A GMA fuse for 230 VAC operation.

When the unit is powered up, a relay mutes all outputs for a few seconds by shorting them to ground. This measure effectively prevents potentially damaging turn-on transients from being fed to the drivers via the power amplifiers.

Signal Connection

Input signal connection is by means of female XLR connectors to an electronically balanced differential input amplifier. The outputs are driven via a high-current single-ended output amplifier through male XLR connectors.

All XLR connectors are wired pin 2 hot (positive) and phase integrity is maintained between the inputs and outputs subject to any internal phase compensation.

In many live sound applications, the MX200i is part of a "processing rack" at the mix position, connected to the power amp racks backstage via a long snake. The MX200i output stage has been engineered for the best possible performance in this application. It uses a single-ended unbalanced circuit that is optimized for driving large capacitative loads (long cables) without becoming unstable. It is also designed to drive typical amplifier inputs without any loss in common-mode rejection capability.

The common-mode rejection ratio is usually expressed in dB: It is a measure of the input circuit's ability to filter out signals that are common to both the left and right channels (such as 60 Hz hum induced by AC lines) from those that are different at both inputs (such as music). A key factor in maintaining CMRR performance is the ratio between the output impedance of the MX Series processor and the input impedance of the amplifier.

The output impedance of the MX Series processors is only 10 Ohms, while a typical amplifier has an input impedance of at least 10,000 Ohms. Using the 1:1000 impedance ratio as an example, we could calculate a "worst case" CMRR of 66 dB. By comparison, tolerance errors caused by building the input stage with 1% resistors can reduce CMRR to 34 dB. Even when .1% resistors are used, the CMRR can fall as low as 54 dB. Of course, if input impedance is higher than 10 kOhms, the effect of the MX Series processor's output impedance would be even less.

The unbalanced MX Series output stage does not provide protection against the large current s that can flow through ground loops, but an electronically balanced output offers no more protection against these dangers. To protect the unit's circuitry, we have placed a network of capacitors between the signal ground (Pin 1) and chassis ground. Only RF frequencies can pass through this capacitor network. The rear panel Ground Lift switch disconnects Pin 1 from signal ground, preventing ground loops when the cable shield is connected to Pin 1 at both ends.

If you intend to drive an unbalanced input stage, you cannot arbitrarily connect either Pin 2 or Pin 3 to Pin 1 (ground): You must ground Pin 3. This output stage is safe, quiet and reliable under all normal operating conditions. In extreme situations involving huge differences in ground potential between the processing rack and the amp rack (for instance, if each rack is powered by a separate generator with its own floating ground potential) isolation transformers may be required, as they would also be with a balanced output stage.

Grounding Considerations

Chassis ground is connected to the mains or safety ground via the AC line cord, and is also connected to all XLR cases. For maximum resistance to RF interference, signal ground is not directly connected to the chassis ground but is capacitively coupled. In normal operation all XLR pin 1's are connected to signal ground. Pressing the rear panel ground lift switch (into the "LIFT" position) disconnects all output pin 1's from signal ground (referred to as floating the shields). This can be useful in eliminating ground loop induced hum when used with long cable runs.

WARNING: Under no circumstances should equipment requiring a mains ground be run with the ground wire disconnected.

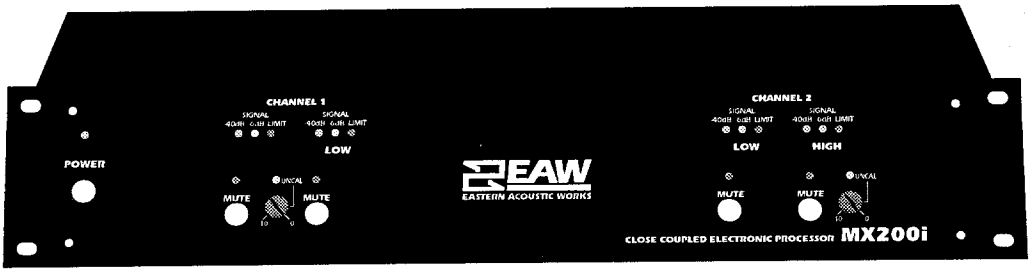
Internal Servicing

With the exception of the master limit threshold control, there are no user serviceable parts inside the unit. Under no circumstances should the presets, SIP or PCB Programming modules be adjusted or modified by anyone other than an authorized service engineer. These modules hold the components that define the filter frequencies, phase correction, channel gains and channel limit thresholds. Also on modules are the components that preset the degree of bass boost in the Sub-bass excursion control circuit and the frequency of the system high-pass filter that removes unwanted frequencies below the cutoff point of the sub-bass speakers. These settings have been optimized at the factory after careful testing and are not intended to be modified in the field.

The two internal fuses are designed solely to protect internal circuitry from damage in the event of catastrophic power supply failure. If one or both of the internal fuses blows, immediately bring the unit to an authorized service agency. In the event of a rear panel AC line fuse failure, replace only with the type and rating specified on the rear panel and in the power connection section of this manual. If the rear panel AC line fuse blows repeatedly, have the unit checked by an authorized service agency.

Control Description

By closely coupling the exact performance parameters of the MX200i at the factory to a specific loudspeaker system (i.e. EAW's SM200iH, JF260/SB528) we can provide better performance than is possible with normal crossover units. As a side benefit we have significantly reduced the number of adjustments and controls the end user must deal with. The few controls present on the MX200i are switches rather than continuously variable controls. This simplifies operation, minimizes the risk of incorrect setup, and maximizes repeatability.



General Controls & Indicators

Power Switch

The power switch is located at the extreme left of the front panel. Above it is a green LED power indicator. When the unit is powered up, a relay mutes all outputs for few seconds by shorting them to ground. This effectively prevents potentially damaging transients from being fed to the drivers via the power amplifiers.

Mute Switch & LED

Each channel has independent mute switches for both frequency bands. The mute switches are useful at setup time as diagnostic aids for verifying the correct operation of individual speaker/amplifier elements. When a band is muted, a red LED illuminates above the appropriate mute switch. Typically these mute switches would only be used during setup and troubleshooting.

Signal Level Indicators

Located above the mute and level controls are three output signal level indicator LEDs. The green LED lights at signal levels above -40 dB (relative to the limit threshold) and is generally used to indicate signal presence. The yellow LED indicates signal levels above -6 dB (relative to limit threshold) and is used to indicate the approach of limiting. The red LED indicates the activation of the limiter protection circuit. Relative limiter thresholds among the bands are set by the factory for the specific system configuration. Once set, they track as a group with the internal master limit threshold control.

Practical Considerations

Physical

The case of the MX200i CCEP™ is fully enclosed to prevent the ingress of foreign matter. It should be mounted no closer than two inches from the nearest power amplifier, to avoid picking up hum from inadequately shielded power amp transformers, and should not be located where air convection currents from power amplifiers could cause undue heating. Adequate ventilation should be ensured. In applications where it will be mounted along with power amps, fan-forced ventilation of the rack case assembly is strongly recommended to prevent heat buildup within the rack that could cause premature failure of the MX200i's electronic components and/or power supply. The use of shock mounted equipment racks is recommended to prevent undue stress on the front panel during transit.

Environmental

As with all electronic equipment, it is unwise to use the MX200i CCEP™ in damp or excessively humid conditions. Attention should be given to proper positioning in outdoor concert applications. If the unit should become damp due to uncontrollable circumstances, make sure the unit is thoroughly dry before operation.

Cleaning

The MX200i CCEP™ may be cleaned with a damp cloth to which a little light detergent or cleaning liquid has been added, but the use of suds or foam as well as petroleum spirits, thinners or other solvent cleaners is not advised. These cleaners can cause serious damage to the finish of the unit.

Installation Notes

The MX200i CCEP™ normally arrives from the factory with Programming Modules configured for use with your specified loudspeaker system (e.g. EAW SM200iH, JF260/SB528, etc.) These modules contain all of the information to program the MX200i with optimal levels, crossover frequencies, slopes, phase angles, and levels for the specified loudspeaker system. To change the configuration of the MX200i we recommend that you send the unit back to the factory for updating where it can fully tested on our automated equipment. In the unlikely event that you need to change the configuration in the field, please refer to Appendix B of this manual.

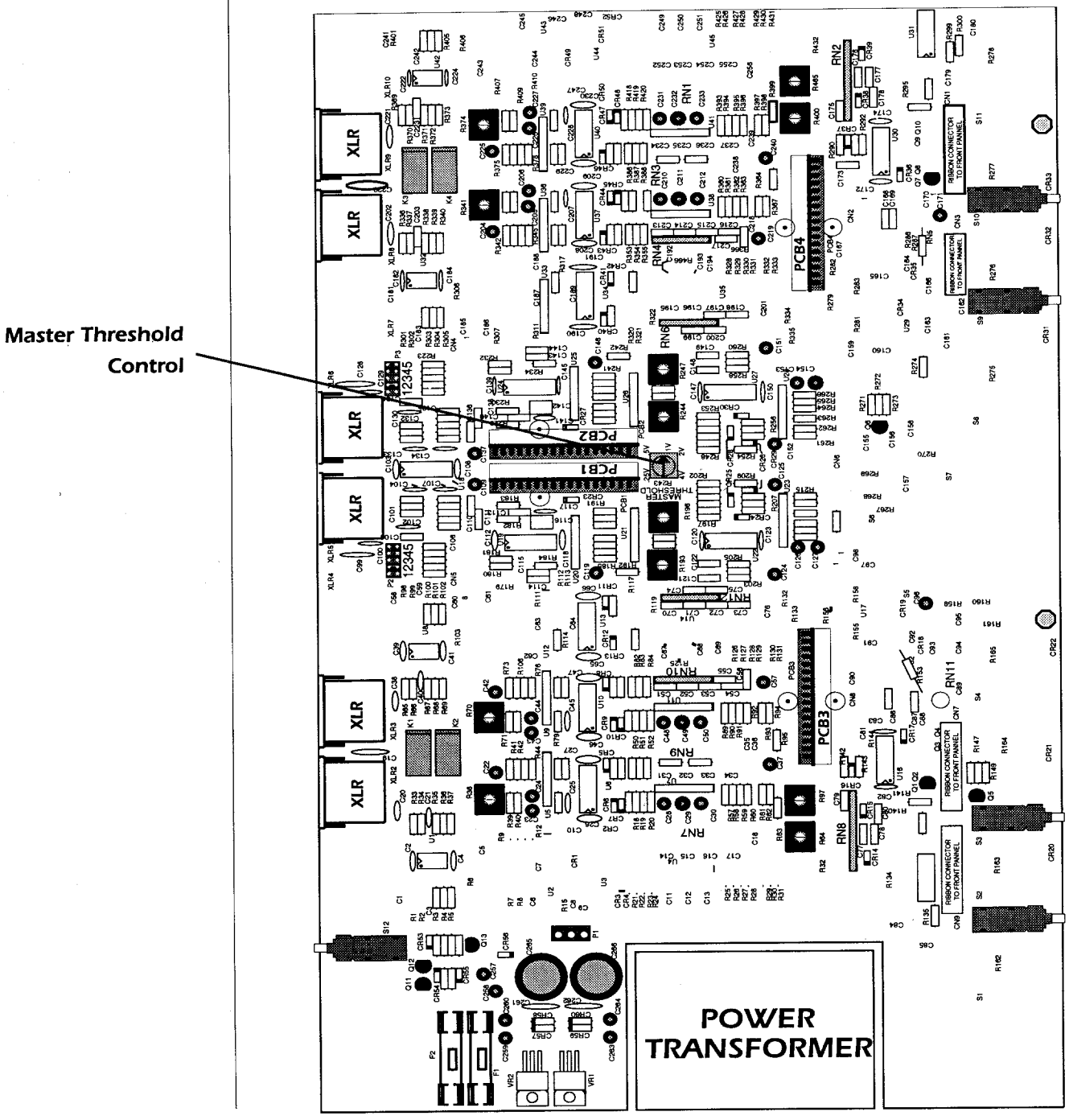
Master Threshold Control

The master threshold control adjusts the overall output level before protection limiting is triggered. It is a PC board mounted rotary potentiometer located internally and requires the removal of the top cover and a small flat head screwdriver for adjustment. The MX200i's master

threshold control is normally set for use with amplifiers having an input sensitivity of 1.0 volts for maximum output. You can adjust the master threshold control inside the MX200i if you are using amplifiers of different sensitivity. Additionally, the master threshold may be lowered for additional driver protection or to reduce the maximum output of the system.

A simple method for setting the master threshold control to allow maximum output from your amplifier is to calibrate the MX200i's low frequency band limit signal LED to the amplifier's clip or error lights. The LF amplifier should be used for calibration purposes unless you are specifically trying to protect a particular driver. In that case, the clip lights on that driver's amplifier can be used for calibration. Drive the calibration amp with a signal (ideally a 150 Hz sine wave when the LF amplifier is used) of sufficient level to trigger the limiter. Then back off the master threshold control until the amplifier's clip indicators no longer light.

If your amplifier does not have clip indicators, or if you would like to ensure the accuracy of the calibration procedure, amplifier clipping can be observed by watching the waveform on an oscilloscope.



It should be noted that the master threshold control affects both channels and all frequency bands. The individual band limit settings are preset at the factory on the program modules.

This limit level may be set even lower if additional driver protection is required, as may be the case in discotheque installations operated by non-technical personnel. In such cases, it is prudent to set the limiters so that the maximum output voltage of the power amplifiers cannot exceed the rated speaker power at the appropriate impedance. This may be simply calculated by:

$$\text{Maximum Voltage} = \sqrt{\text{Maximum Power (Watts)} \times \text{Impedance (Ohms)}}$$

This table shows the voltage for various power levels at 4Ω, 8Ω and 16Ω

Maximum Power Level	Maximum Voltage 4Ω	Maximum Voltage 8Ω	Maximum Voltage 16Ω
10 Watts	6.3 Volts	8.9 Volts	12.6 Volts
20 Watts	8.9 Volts	12.6 Volts	17.9 Volts
40 Watts	12.6 Volts	17.9 Volts	25.3 Volts
50 Watts	14.1 Volts	20.0 Volts	28.3 Volts
60 Watts	15.5 Volts	21.9 Volts	31.0 Volts
75 Watts	17.3 Volts	24.5 Volts	34.6 Volts
100 Watts	20.0 Volts	28.3 Volts	40.0 Volts
125 Watts	22.4 Volts	31.6 Volts	44.7 Volts
150 Watts	24.5 Volts	34.6 Volts	49.0 Volts
200 Watts	28.3 Volts	40.0 Volts	56.6 Volts
250 Watts	31.6 Volts	44.7 Volts	63.2 Volts
300 Watts	34.6 Volts	49.0 Volts	69.3 Volts
350 Watts	37.4 Volts	52.9 Volts	74.8 Volts
400 Watts	40.0 Volts	56.6 Volts	80.0 Volts
500 Watts	44.7 Volts	63.2 Volts	89.4 Volts
1000 Watts	63.2 Volts	89.4 Volts	126.5 Volts

Individual Band Thresholds

Should you want to limit power to individual bands for additional protection, to limit band output or to compensate for different amplifier sensitivities, you can use the following formula to set the appropriate resistor:

R_{TH} = threshold resistor value in ohms

V_{SENS} = amplifer input sensitiity

A_{dB} = level in dB of threshold level relative to V_{SENS}

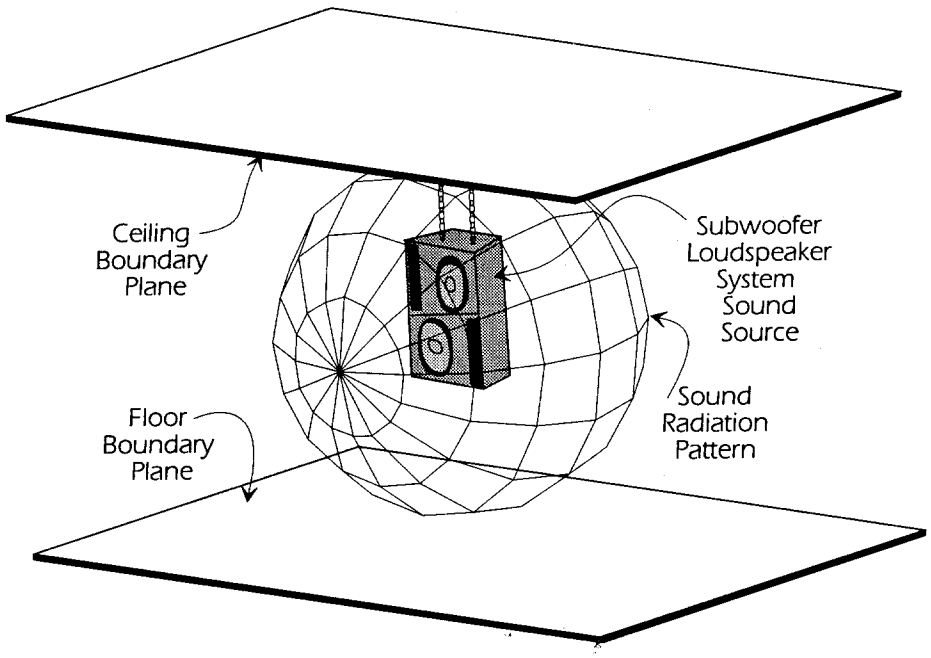
$$R_{TH} = \frac{4 \times 10^6}{20 \log V_{SENS} + A_{dB} + 28.947}$$

Subwoofer Placement

The criteria for optimum subwoofer location are quite different than those for the main loudspeaker systems. While the main system is aimed for ideal coverage of the intended audience, the subwoofers' inherent omnidirectionality makes coverage virtually irrelevant. Subwoofers should be placed to optimize coupling to the room. A few examples of subwoofer placements and the effects they can have on performance follow.

Spherical Radiation

When a loudspeaker system is suspended in free field and is reproducing frequencies with wave lengths larger than the front baffle of the system, it is inherently a full sphere radiator as pictured below. In effect, the sound waves do not "see" the baffle and the system acts as a true point source, radiating its energy equally in all directions.



While this may sound like a good thing, the only instance when a loudspeaker would be suspended in free field is when it is hanging (for instance, when the subwoofers are flown with the main system). As can be clearly seen in the illustration above, half the sound energy is going above the system into the ceiling. The energy that is radiating upward is totally wasted in all but a very few applications, causing audible loss of low frequency output. Poor room coupling when the subwoofers are placed on portable staging and cannot couple to the floor properly will also result in spherical radiation causing similar loss of low frequency energy.

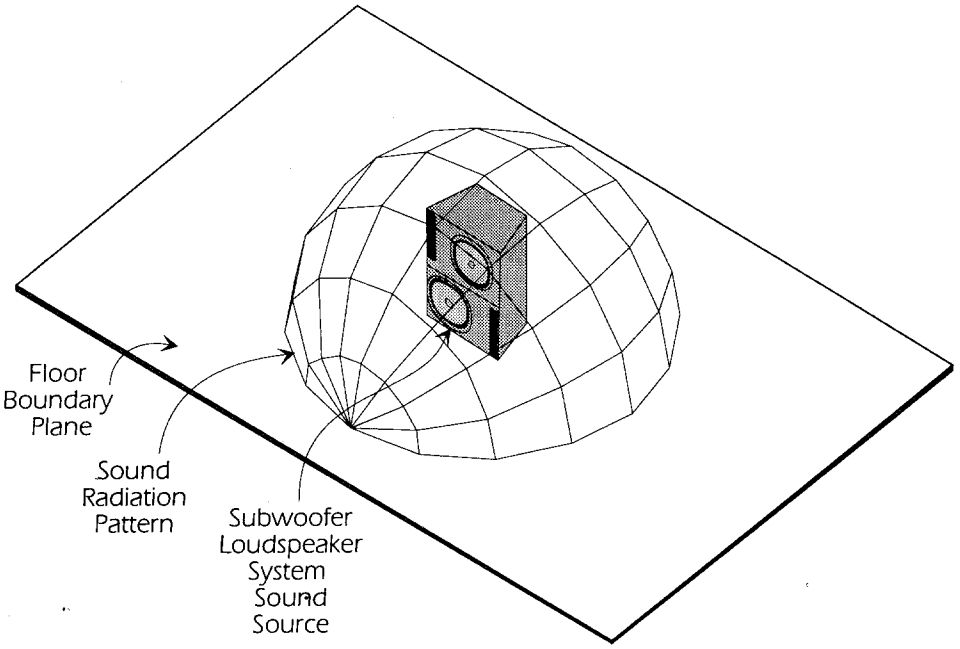
We strongly recommend that you leave your subwoofers on the ground even if you are flying the main system. If you must fly your subwoofers, use at least twice the number of subs as you would otherwise.

It should be noted that most manufacturers, including EAW, specify their low frequency systems into half space (see next section) and you should decrease the rated sensitivity and maximum sound pressure level specifications by 3 dB (or half) if you are planning to fly your subwoofers.

Half Sphere Radiation

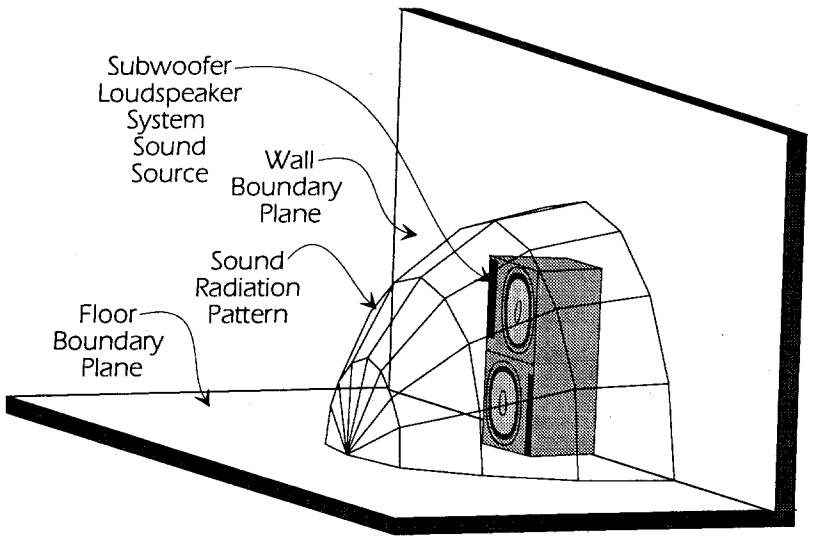
Half sphere radiation, as its name implies, occurs when a subwoofer system is loaded into half space, by simply placing it on the floor. This increases the output at any point at a given distance within its radiation pattern by 3 dB as compared to its free field performance.

This is the typical situation in most applications.



Quarter Sphere Radiation

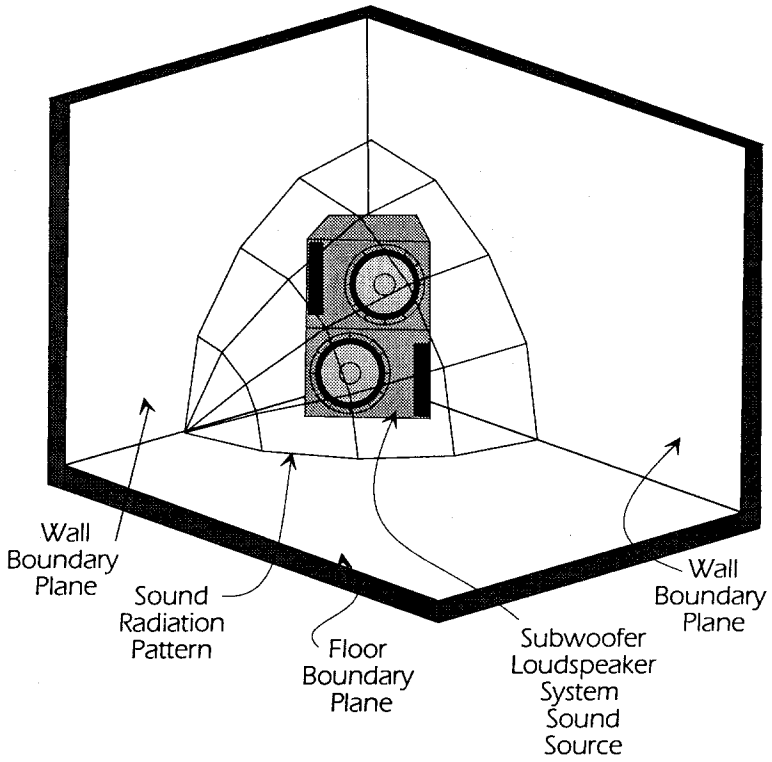
Quarter sphere radiation occurs when the subwoofer is placed at the intersection of the floor and a wall. If a given venue allows this type of placement, it is a good way to increase low frequency output. It should be noted that for this placement to work the wall must be acoustically reflective at low frequencies. Most walls built with a wood frame and plaster do not reflect low frequencies. Instead, they pass them through or absorb them by vibrating sympathetically with the sound source.



Subwoofers placed so as to offer quarter sphere radiation exhibit 6 dB more output at a given distance than in free field and 3 dB more output than if radiating into half space.

Eighth Sphere Radiation

Eighth sphere radiation occurs when the subwoofer is placed on the floor in a corner. While this type of location is rare in portable applications, it can be effectively used in many permanent applications. As noted above, the walls must be rigid and acoustically reflective for this technique to work.



Eighth sphere radiation increases the output of a subwoofer at a given distance by 9 dB as compared to free field, 6 dB as compared to sitting on the floor in half space, and an additional 3 dB as compared to quarter space loading.

In many installed applications, corner placement allows the use of fewer subwoofers than normal.

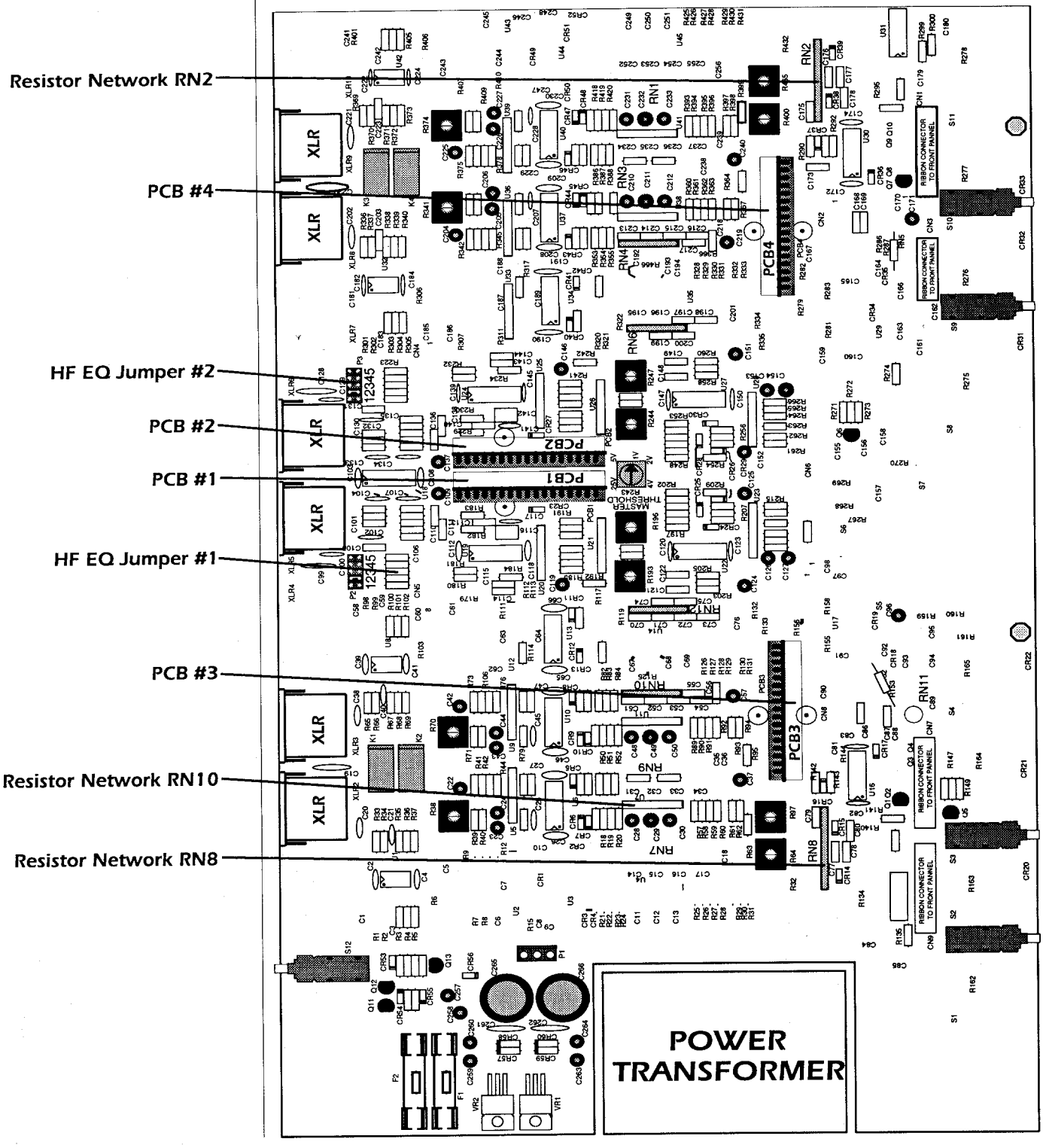
MX200i Programming

PCB's, SIP's & Jumpers

The MX200i is programed for a specific system through PCB modules, SIP resistor networks and high frequency EQ jumpers. To change the configuration of the MX200i we strongly recommend that you send the unit back to the factory for updating where it can be fully tested on our automated equipment. In the unlikely event that you need to change the configuration in the field, the information in this appendix covers the settings for these modules as of the dates listed. Before attempting to adjust your unit, please contact the factory for current configuration data. You should also make sure that all electronic components are tested for precision.

MX200i-2 Configuration

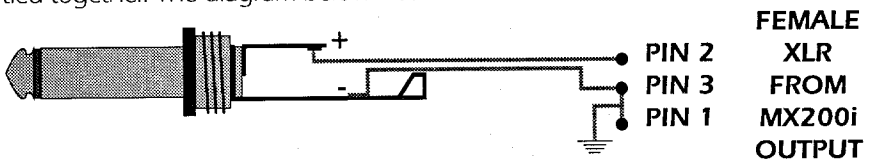
EAW MX200i-2 CCEP™ Processor Configuration Table



Connecting The MX200i

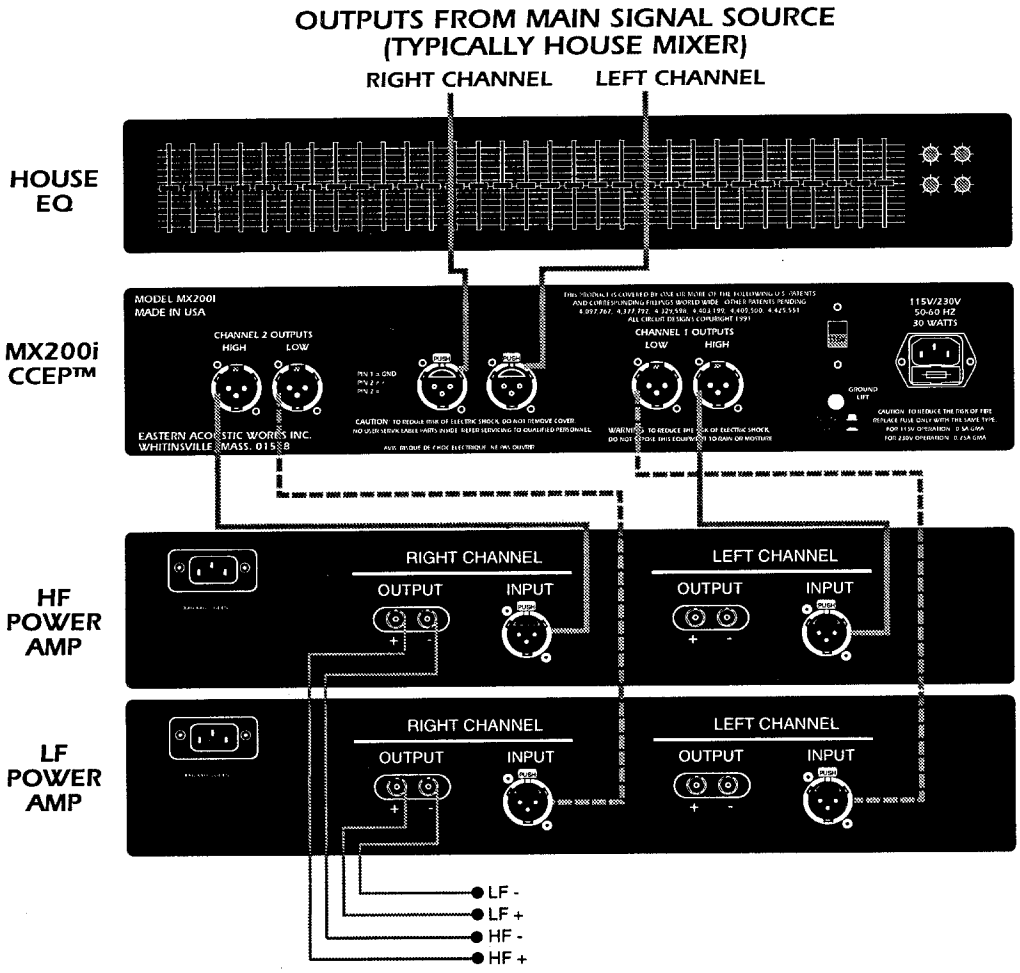
Unbalanced Terminations

For applications where the MX200i is being used with unbalanced Semi-Pro signal sources or power amps you should use the MX200i signal on PIN #2 as the positive signal. PIN #3 and PIN #1 should be tied together and used as the negative/ground signal. In unbalanced applications, there will be significant loss in signal due to improper wiring if PIN #1 and PIN #3 are not tied together. The diagram below illustrates how this is done.

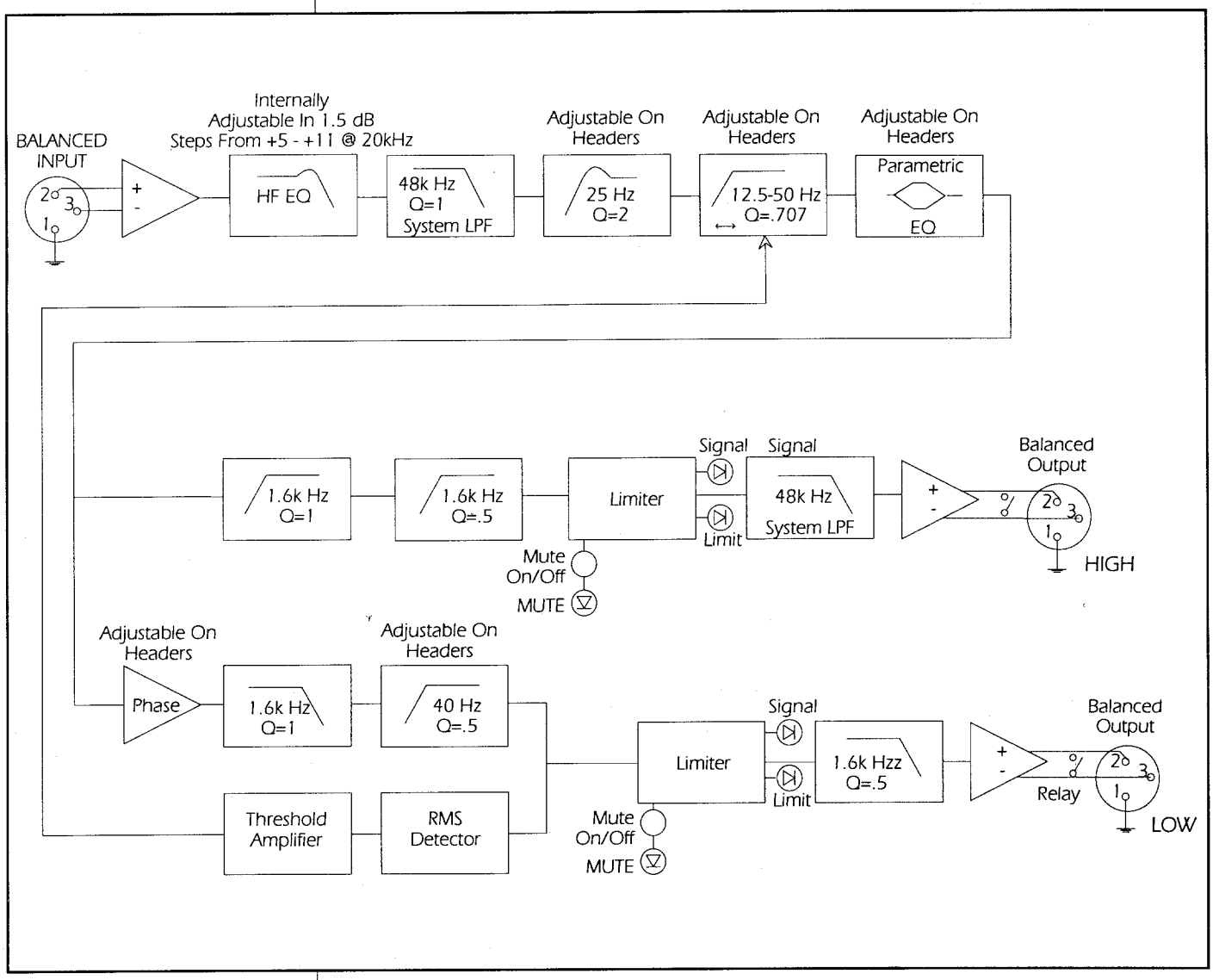


Connection Diagram

The diagram below shows the typical high and low level cabling for using KF300i/SB330 and MH662/SB250 or SB625 systems.



MX200i Block Diagram



Schematic Diagrams

Schematic Diagrams and additional servicing information can be obtained by contacting the factory or the service department of the EAW distributor for your country.