7 Optional functions

The console is factory wired to suit what Yamaha engineers believe to be the greatest number of applications. Yamaha recognizes, however, that there are certain functions which must be altered for certain specific applications. In designing this console, a number of optional functions have been built in, and can be selected by moving factory preset switches or jumpers within certain modules.

WARNING

Underwriter's Laboratories (UL) requires that we inform you there are no user-serviceable parts inside the PM3500M. Only qualified service personnel should attempt to open the meter bridge, to remove a module, or to gain access to the inside of the console or power supply for any purpose.
We at Yamaha additionally caution you never to open the console and remove or install a module for the purpose of inspection, replacement or changing the preset switches unless the power has first been turned off. If a module is removed or installed with power on, the circuitry may be damaged. Unless you are a qualified service technician, do not plug in the AC cord while the interior of the power supply is exposed; dangerous voltages may exist within the chassis, and lethal shock is possible.

7.1 Removing and installing a module

1. Loosen the screws (1) on the front of the meter bridge. The number of screws differs according to the number of input channels. (Fig.1)
2. Loosen the screws (2) on the rear of the meter bridge. (Fig.2)
3. Open the meter bridge as shown in Fig.1.

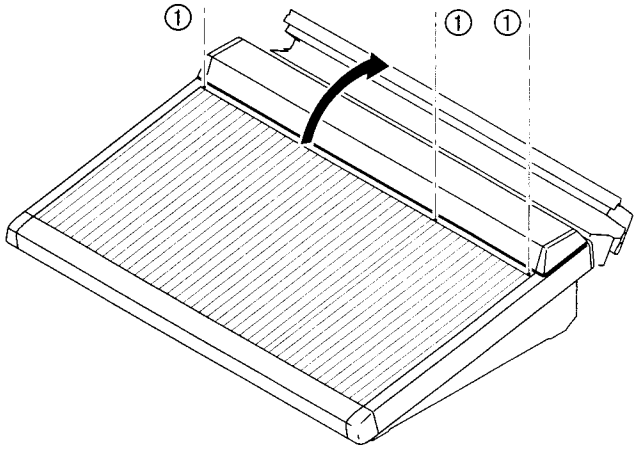


Fig.1

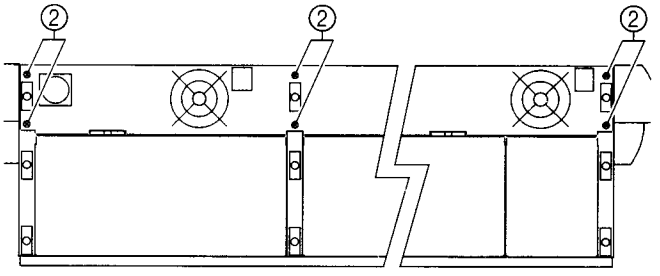


Fig.2

4. Remove the ground connection (3) on the ground bridge. (Fig.3)
5. Remove the ground bridge holding screws so that the ground bridge (4) can be raised and the three connections (5) disconnected. (Fig.3)

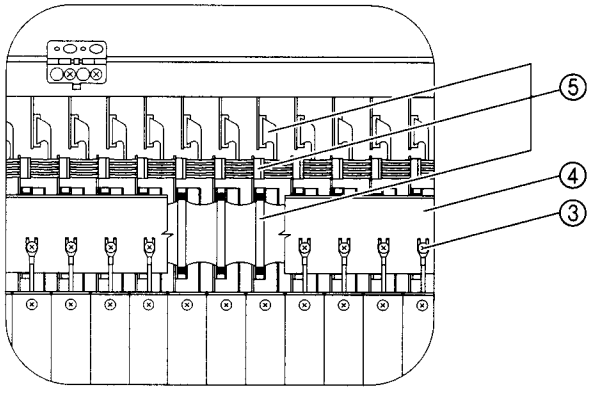


Fig.3

6. Loosen the retaining screws on the top and bottom of the module. These screws (6) should remain in the module. (Fig.4)
7. Lift up the bottom of the module, then carefully pull the module out of the console. (Fig.4)

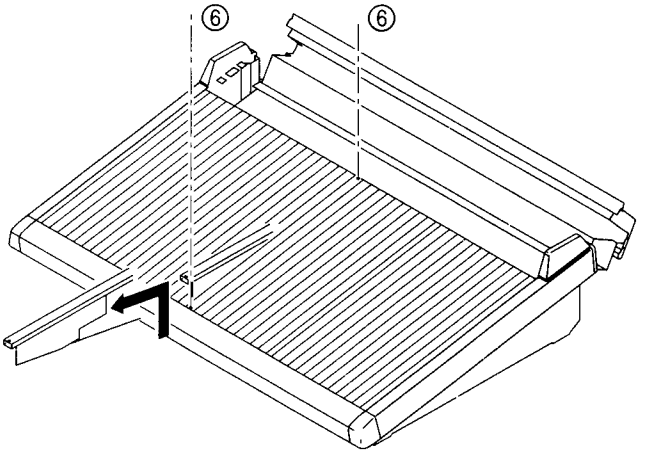
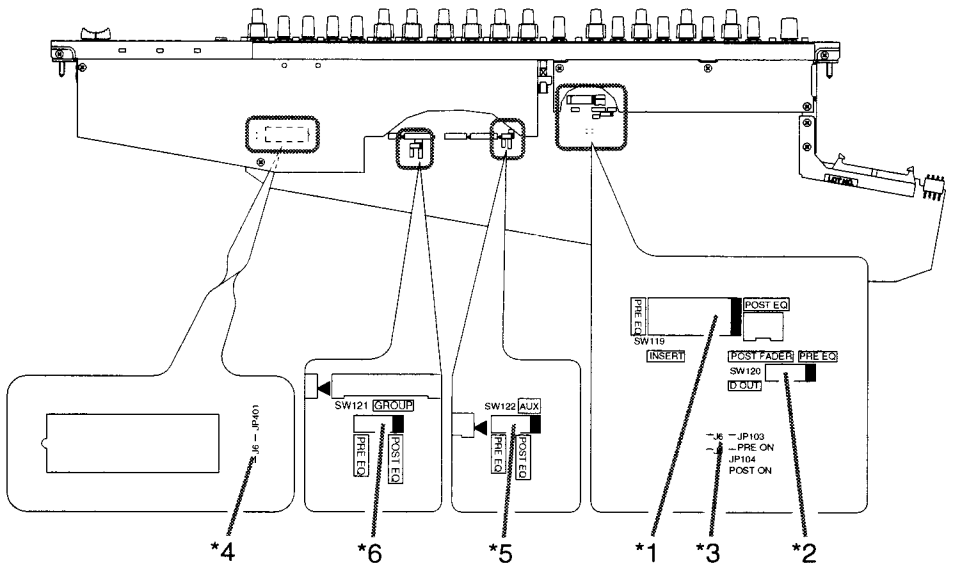


Fig.4

Installation of a module should be carried out by performing this procedure in reverse.

7.2 Monaural input modules



The monaural input modules can have the following settings changed by switches or jumpers mounted on the module boards:

	Setting	Options	Factory setting
*1	Insert I/O	pre-EQ / post-EQ	post-EQ
*2	Direct out	pre-EQ/ post-fader	pre-EQ
*3	Direct out	pre-ON / post-ON	pre-ON
*4	Solo Safe	on (safe)/off	on (safe)
*5	Aux 1 through 8	pre-EQ / post-EQ	post-EQ
*6	Group 1 through 8	pre-EQ/post-EQ	post-EQ

7.2.1 Insert I/O pre- or post-EQ (switch)

A slide switch in each monaural input module permits the INSERT I/O point to be altered. As shipped, the console is set so that the INSERT OUT point is derived after the EQ. If you want the Insert Out to be pre-EQ, move the switch to the appropriate position, as illustrated.

7.2.2 Direct out pre-EQ or post-fader (switch)

A slide switch in each monaural input module permits the direct out point to be altered. As shipped, the console is set so that the direct out point is derived pre-EQ.
If you want the direct out to be post-fader, move the switch to the appropriate position, as illustrated.

7.2.3 Direct out pre- or post-ON switch (jumper)

A jumper in each monaural input module permits the direct out point to be altered. As shipped, the direct out point comes ahead of the Channel ON switch, and is thus not affected by the scene memory function. By changing internal jumpers, you can alter the direct out point to be post-ON switch, as illustrated.

7.2.4 SOLO safe (jumper)

A jumper in each monaural input module allows the module to be protected from SOLOing (see page 18 for details of solo operations). As shipped, this jumper is configured as ON (the module cannot be soloed).

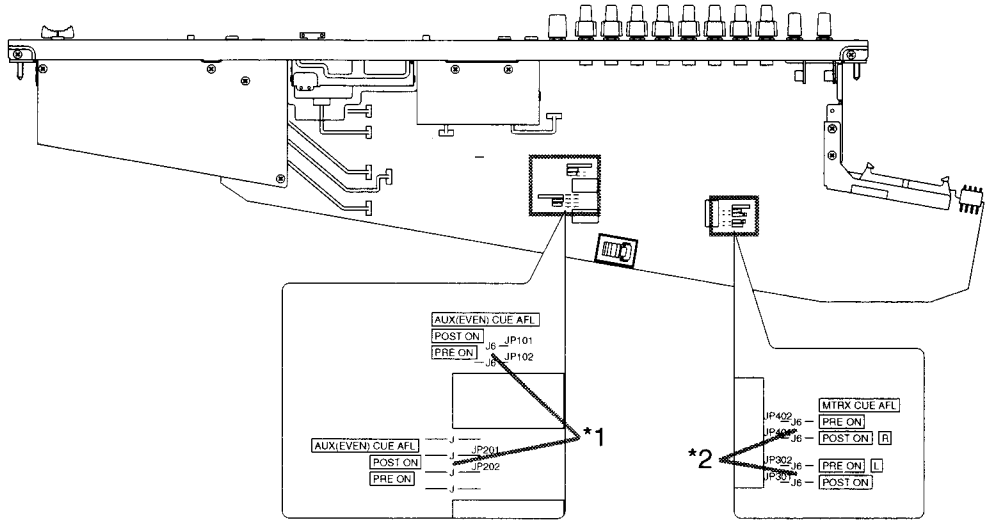
7.2.5 AUX 1 through 8 pre-EQ or post-EQ (switch)

A slide switch in each monaural input module affects the points of all eight AUX busses. As shipped, the console is set so that these points are derived after the EQ. If you want the AUX sends to be derived pre-EQ, move the switch to the appropriate position, as illustrated.

7.2.6 Group 1 through 8 pre-EQ or post-EQ (switch)

A slide switch in each monaural input module affects the points of all eight group busses. As shipped, the console is set so that these points are derived after the EQ. If you want the group sends to be derived pre-EQ, move the switch to the appropriate position, as illustrated.

7.3 Group master modules 1



The group master modules (1) can have the following settings changed (which affect the operation of the aux and matrix busses housed on the module) by switches or jumpers mounted on the module boards:

	Setting	Options	Factory setting
*1	AUX CUE	pre-ON /post-ON	post-ON
*2	Matrix CUE AFL	pre-ON / post-ON	post-ON

7.3.1 AUX CUE AFL pre- /post-ON jumpers

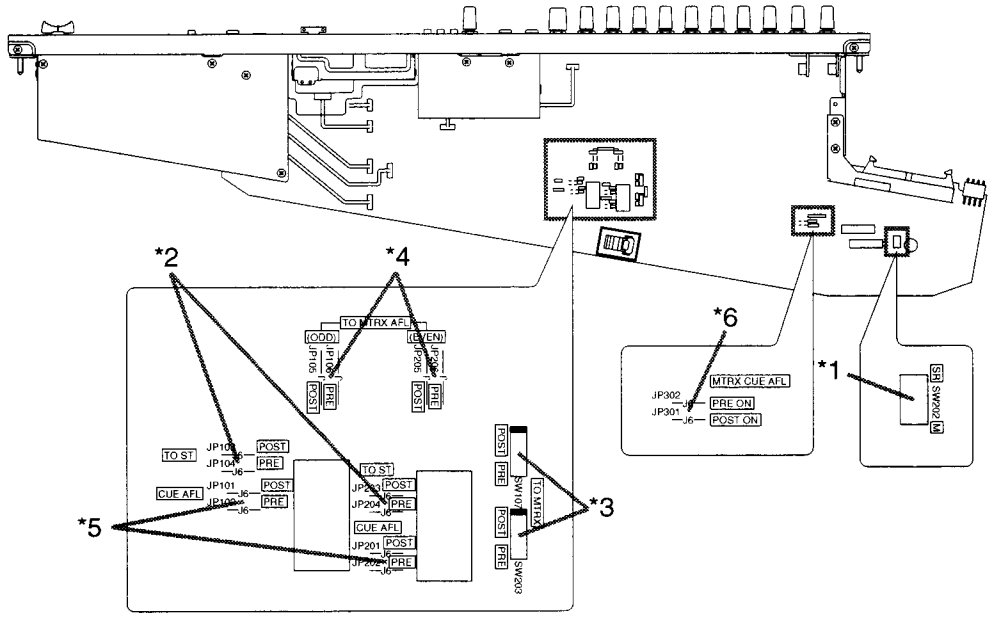
As shipped, aux CUE AFL levels are derived post-ON switch. If these jumpers are changed, the aux AFL levels are independent of the matrix ON switches.

7.3.2 Matrix CUE AFL pre- /post-ON jumpers

As shipped, matrix CUE AFL levels are derived post-ON switch. If these jumpers are changed, the matrix CUE AFL levels are independent of the matrix ON switches. Note that there are two jumpers for each side of the stereo matrix bus.

7.4 Group master modules 2

The group master modules (2) can have the following settings changed (which affect the operation of the group and matrix busses housed on the module) by switches or jumpers mounted on the module boards:



	Setting	Options	Factory setting
*1	Group sum gain	0dB /+6dB	6dB
*2	Group to ST	pre-ON /post-ON	post-ON
*3	Group to matrix	pre-fader/ post-fader	post-fader
*4	Group to matrix	pre-ON / post-ON	post-ON
*5	Group CUE AFL	pre-ON / post-ON	post-ON
*6	Matrix CUE AFL	pre-ON / post-ON	post-ON

7.4.1 Group sum gain (0, +6dB) switch

Each group module can have the group sum gain cut by 6dB when the switch shown in the illustration above is moved to the "SR" (sound reinforcement) position from the "M" (sound reinforcement) position. The factory setting is the "M" (6dB boost) position. The switch is logically prior to the sum peak indicator. Note that one switch affects both groups.

7.4.2 Group-to-stereo jumpers

This pair of jumpers can change the group-to-stereo switch [49] (page 24) function from its factory setting of post-ON switch, to pre-ON. In other words, if these jumpers are moved, the group-to-stereo switch is independent of the ON switch status.

7.4.3 Group-to-matrix pre- /post-fader jumpers

This pair of jumpers can change the group-to-matrix switch [50] (page 24) function from its factory setting of post-group fader [52] (page 25), to pre-fader. In other words, if these jumpers are moved, the group-to-matrix level is independent of the group fader setting.

7.4.4 Matrix CUE AFL pre- /post-ON jumpers

As shipped, matrix CUE AFL levels are derived post-ON switch. If this jumper is changed, the matrix CUE AFL levels are independent of the matrix ON switches.

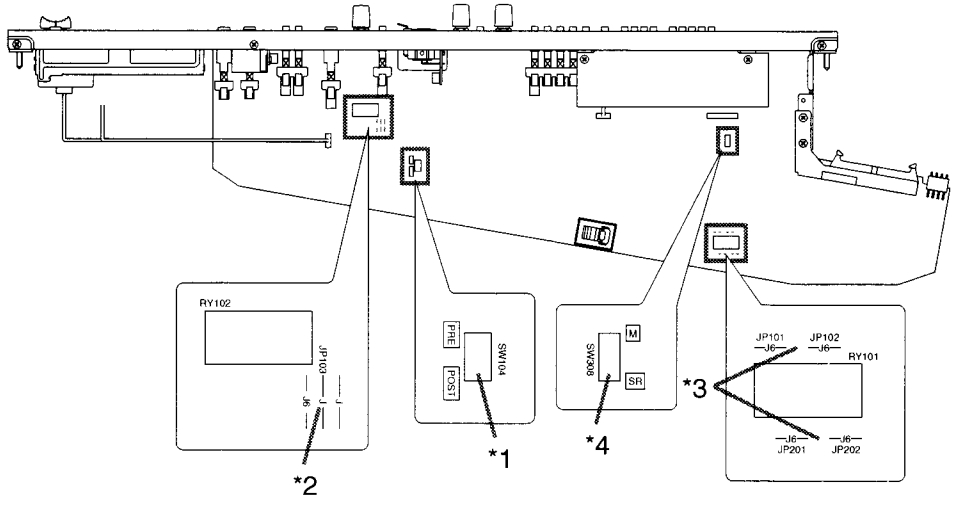
7.4.5 Group CUE AFL pre- /post-ON jumpers

As shipped, group CUE AFL levels are derived post-ON switch. If these jumpers are changed, the group CUE AFL levels are independent of the group ON switches.

7.4.6 Group-to-stereo pre- / post ON jumpers

This pair of jumpers can change the group-to-matrix switch [50] (page 24) function from its factory setting of post-ON switch [54] (page 25), to pre-ON. In other words, if these jumpers are moved, the group-to-matrix switches are independent of the ON switch status.

7.5 Stereo master module



The stereo master module can have the following settings changed by switches or jumpers mounted on the module board:

	Setting	Options	Factory setting
*1	Stereo-to-matrix	pre-fader/ post-fader	post-fader
*2	Stereo-to-matrix	pre-ON / post-ON	post-ON
*3	Stereo CUE AFL	pre-ON / post-ON	post-ON
*4	To GRP level	0dB / -6dB	0dB

7.5.1 Stereo-to-matrix pre- /post-fader jumpers

This pair of jumpers can change the group-to-matrix switch [67] (page 27) function from its factory setting of post-stereo fader [72] (page 27), to pre-fader. In other words, if these jumpers are moved, the stereo-to-matrix level is independent of the stereo fader setting.

7.5.2 Stereo-to-matrix pre- / post ON jumpers

This pair of jumpers can change the group-to-matrix switch [67] (page 27) function from its factory setting of post-ON switch [70] (page 27), to pre-ON. In other words, if these jumpers are moved, the stereo-to-matrix switch is independent of the ON switch status.

7.5.3 Stereo CUE AFL pre- /post-ON jumpers

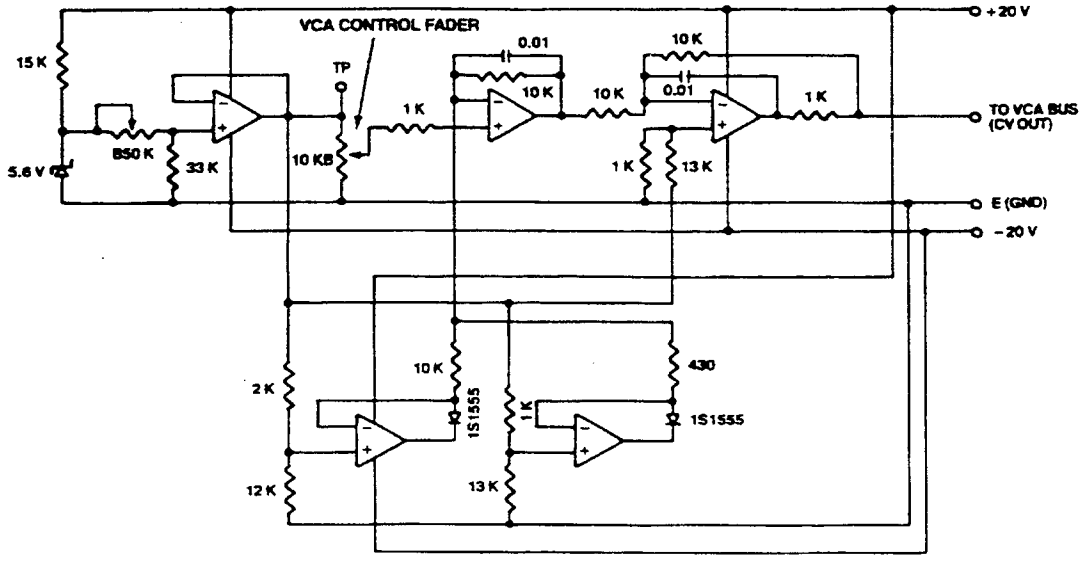
As shipped, stereo CUE AFL levels are derived post-ON switch [70] (page 27). If these jumpers are changed, the stereo CUE AFL levels are independent of the stereo ON switch setting.

7.5.4 Talkback-to-group gain (0, –6dB) switch

The stereo module can have the gain of the talkback bus routed to the group and AUX busses attenuated by 6dB when the switch shown in the illustration above is moved to the "–6dB" (monitor) position from the "0dB" (sound reinforcement) position. The factory setting is the 0dB position.

7.6 Hints on circuitry for remote control of the VCA masters

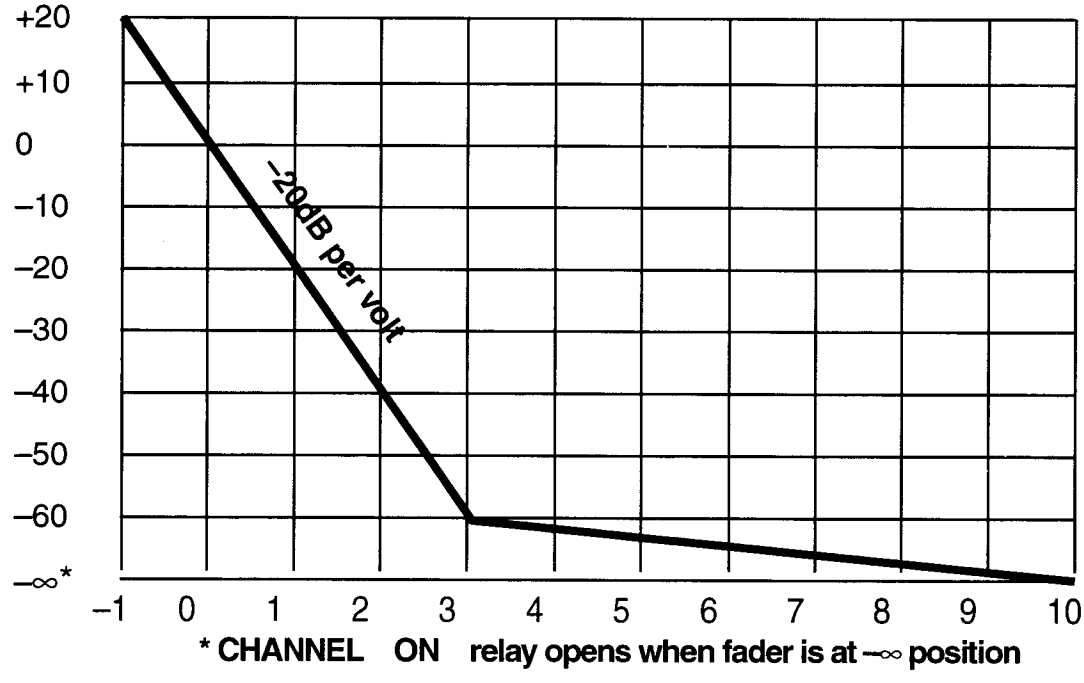
The VCA CONTROL [107] (page 34) connector on the rear panel is provided primarily so that two consoles may be linked, and just one console's VCA MASTER FADERS will affect both consoles input channels. However, it is possible to create an independent controller so that these functions can be remotely controlled from the console. One possible application would be to remotely adjust mix levels in the middle of a venue even though the console is located in a booth. Another possible application would be the creation of a limited automation system. Yamaha does not offer detailed instructions for this type of remote control. However, we do present here a schematic diagram of the VCA control fader circuit which, if constructed externally by a competent technician and interfaced via the VCA CONTROL connector, can do the job.



Yamaha part no.	Quantity	Suffix letter	Item	Value or type
UA21410	2	K	Mylar capacitor	0.01μF, 50V
HU07543	1	F	Metalized film resistor	430Ω, 1/4W
HU07610	4	F	Metalized film resistor	1kΩ, 1/4W
HU07620	1	F	Metalized film resistor	2kΩ, 1/4W
HU07710	4	F	Metalized film resistor	10kΩ, 1/4W
HU07712	1	F	Metalized film resistor	12kΩ, 1/4W

Yamaha part no.	Quantity	Suffix letter	Item	Value or type
HU07713	2	F	Metalized film resistor	12kΩ, $^1/_4$W
HK05715	1	J	Carbon resistor	13kΩ, $^1/_4$W
HK05733	1	J	Carbon resistor	33kΩ, $^1/_4$W
IG06920	3		IC amp	MJM2041DD
HT56009	1	B	Semi-fixed VR (trimmer)	50kΩ
IF00004	2		Diode	1S1555
IF00214	1		Zener diode	RD5.6ED2
VA25610	1	B	Slider VR (fader)	10kΩ

Note that the nominal fader position delivers 0 VDC to the VCA, and the VCA operates at unity gain with that input. The control voltage scaling is approximately -20dB per volt DC in the linear range of fader travel (above -50dB on the fader scale). Thus, at maximum upward fader travel, a single fader will deliver about 0.5 volt negative, which drives the VCA to +10dB of gain. If several VCA faders are set above nominal and assigned to a channel, the maximum negative voltage that will be applied to the VCA is -1.2 VDC (a DC limiter circuit prevents any more negative voltage from being passed and turns on the VCA MAX LED). This corresponds to +24dB of gain. At minimum VCA fader setting, the output is +10 VDC, corresponding to over 100dB of attenuation.



The VCA and MUTE connections are illustrated on page 34. In order to mute a group, ground the conductor corresponding to that group. The console's VCA MASTER/SLAVE and/or MUTE MASTER/SLAVE switch(es) must be set to the SLAVE position in order for the corresponding remote control to take effect on the designated busses and mute groups.

WARNING

Only qualified service technicians should attempt to construct and connect any circuit to interface with the PM3500 VCA CONTROL connector. A circuit or wiring error could severely damage the console, and such damage is not covered under the terms of the PM3500 warranty. Improper grounding could also create noise and/or safety hazards. This information is provided only to illustrate the extent of such a modification; the PM3500 Service Manual should be consulted before actually building any remote control device.

8 Operating notes and hints

This section is not meant to be comprehensive. Instead, it focuses on a few areas which we feel require special attention, or where a better understanding of the function can lead to far more utility or better sound quality from the PM3500M.

8.1 Console gain structure

In the GAIN STRUCTURE AND LEVELS section of this manual on page 75, we discuss some general considerations regarding levels and system setup. What of the proper gain structure within the PM3500M? How can the many faders and other level controls that affect a given signal all be adjusted for the optimum results? These are important questions to ponder, and we hope you will take some time to study the possibilities.

8.1.1 What is the proper gain structure?

Let's begin with the XLR channel input to the console. According to the INPUT CHARACTERISTICS chart in the SPECIFICATIONS section on page 39, the nominal input level ranges from –70dBu (0.25mV) to +10dBu (2.4V). These are the levels that will supply the ideal signal level throughout the module with the PAD set to 0dB or -30dB, the input GAIN control as required, fader set to its nominal position, and no VCA groups assigned. Actually, a wider range of levels can be accommodated if the fader is adjusted to other-than-nominal position; from –90dBu (0.025mV) minimum to +24dBu (12.3V) maximum.

What is the correct gain structure? Simply stated, it is the level at which there remains adequate headroom so that peaks can be accommodated without clipping, while at the same time there is sufficient "distance" above the noise floor that noise does not become objectionable. If a signal is too high in level (too "hot") at a given point in the console, then peaks or, in extreme cases, the entire signal, will be subject to distortion. If the signal is too low in level, there may be considerably more headroom and less risk of distortion, but the noise will be that much more noticeable, and quiet passages may be masked entirely by residual noise. The "ideal" level, then, where headroom and noise tradeoffs are optimum, is also known as the *nominal* level.

There is no single value for the correct nominal level; it varies throughout the console. This is what the middle graph line in the GAIN STRUCTURE chart depicts. The top graph line indicates the clipping point. The distance between these two lines, at any point along the horizontal signal flow scale, depicts the available headroom. It is important that wide headroom be available throughout a console, not just at the input and output; otherwise multiple signals applied to the busses may add together such that the mixed level approaches clipping, even though the individual feeds to the mix are within their acceptable nominal range. Sometimes a group or master fader can be adjusted to correct this condition, other times it cannot because the distortion is occurring in an amplifier ahead of the fader, and the only cure is to lower the signal levels applied to the bus. How can one know the best course of action when distortion, or excess noise, is encountered?

8.1.2 What affects gain structure?

Firstly, it is important to understand that signal levels can be increased by either increasing amplifier gain (including EQ boost), reducing the amount of attenuation, or adding multiple signals together. Similarly, signal levels can be reduced by either decreasing amplifier gain (including EQ cut), increasing the amount of attenuation (including filter roll-off), or splitting the signal to feed two or more circuits. With this in mind, it becomes clear that the mere act of feeding the "correct" nominal level signal into a console is no guarantee that it will remain at an acceptable level throughout the console.

8.1.3 Establishing the correct input channel settings

In the case of the PM3500M, the input channel LEDs [15] (page 15) make it relatively simple to obtain the correct gain structure at the input stage. Begin with the PAD set at maximum attenuation (-30dB), the GAIN control centered, and apply the typical input signal to the channel input. If none of the LEDs are illuminated, or perhaps just the SIGNAL LED, disengage the attenuation PAD switch to remove the 30dB of attenuation. Adjust the GAIN control as required so that the red PEAK LED flashes on only occasionally, during the loudest program peaks, and the NOMINAL LED flashes frequently or remains on. This establishes the correct channel sensitivity for the initial setup (you may wish to alter these values during an actual program mix, as explained in subsequent paragraphs).

NOTE

It is a good idea to set the group master and stereo master faders at a very low level during the initial stages of setup. This will prevent uncomfortable or even dangerously loud signals from reaching the outputs while preliminary mix setup is established.

Given the correct GAIN and PAD settings, adjust the channel fader to its nominal (0dB) setting. This setting provides the best range of control, with some boost available if the signal must be raised in the mix, and plenty of resolution for fading the signal down in the mix.

Now the channel HP Filter and EQ can be set as desired. If a particular EQ setting causes the channel's PEAK LED to flash on more than occasionally, then the boost applied is raising the signal level too high. The solution is to either reduce the EQ boost setting in one or more bands, or to leave the EQ where you have it for the proper signal contour, and to instead reduce the signal level going into the equalizer. You must do this by adjusting the GAIN control (and, in some cases, also engaging the PAD); the fader does not affect signal going into the EQ. Lower the GAIN only enough so that the PEAK LED does not flash on excessively.

The signal now may be assigned to any of the group mixing busses or the stereo busses. If an assign control is set to PRE-fader position, then the signal level applied to that bus will remain constant regardless of adjustments to the channel fader, depending instead only on the bus assign control setting. In POST-fader position, the assign level will be determined by both the channel's bus assign control and the channel fader.

This same procedure should be followed for each input channel. Once this is done, the bus levels can be examined. Set the VU meter assign switches [82] (page 29) to examine the stereo bus levels and, where applicable, the GROUP OUT levels. One bus at a time, monitor the group mix (use the headphones and the corresponding group CUE switch), and create a rough mix of all input channels which feed this group. Bring down the input faders (or individual input channel-to-bus assign controls) for those sources which are too prominent in the mix; avoid raising input faders to make other sources more prominent. Once this rough mix is established, raise the corresponding group master fader to the nominal position (0dB on the scale). If the signal level on any of these busses becomes too hot (red meter LED flashing on more than occasionally or VU meter pegged at the top of the scale), do not back off the group master fader. Instead, pull down all the input channel faders (or turn down all input channel-to-bus assign controls) which feed this group by an equal amount. (If the channels also happen to be assigned to a given VCA master, you can pull down that VCA master, which, in turn, will reduce the signals applied to the group bus). This will leave the group master fader at the desired nominal position, will preserve the desired balance between input channels, and will keep the bus level from being too hot. Finally, release the group CUE switch.

This same procedure applies to setting the stereo master levels where input channels are assigned directly to the stereo bus. However, you will have to adjust the group master levels on any groups which are assigned to the stereo bus.

8.1.4 Establishing the correct group master settings

Follow the same procedure for each of the other group masters. Once all group masters are calibrated in this manner, the stereo mix can be similarly calibrated. Any group outputs which are to be applied to the stereo mix should be so assigned. Any input channels which are to be applied directly to the stereo mix should be so assigned. Monitor each stereo mix by engaging the stereo CUE switch [71] (page 27), and adjust the various stereo PAN pots as desired.

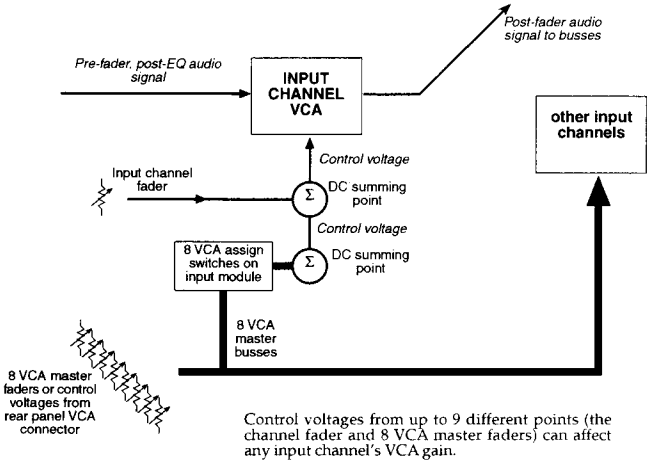
If you're not sure about the stereo position of a given group mix in the stereo perspective, you can temporarily cue that group by pressing its CUE switch. If you want to cue several group busses together, make sure LAST CUE mode is not selected (see "Cue groups and cue priority" on page 16).

With the various signals applied to the stereo mix, bring up the stereo master faders to nominal position and check the bus levels on the L and R VU meters; if they are too high, you can lower all group master faders (if the group-to-stereo switches are engaged, or lower the input channel faders or channel-to-stereo assign controls (if the input channels' direct-to-stereo assign capability is in use). Lower all the affected source faders by a similar amount so as to preserve the mix balance.

8.1.5 How VCA control affects gain structure

Use of the VCA master fader can complicate the gain structure considerably. It is important to set up the input PAD switch and GAIN controls using the technique previously described, including any level compensation for EQ boost. The channel faders initially should be set at nominal position, and any VCA masters to which the input channel is assigned should be set at nominal position as well. When all VCA masters are at their nominal position (green "NOMINAL" LED illuminated), the gain structure can be approached pretty much as outlined previously. If, however, a given input channel is assigned so that it is affected by several VCA masters, and any of those VCA masters is raised in level, then the input channel fader levels are

effectively increased. If enough VCA masters are raised to the point where input channel VCA gain can go no higher, then the offending VCA masters should be lowered slightly to correct the situation, or the channel fader should be lowered. If the adjustments adversely affect the balance between VCA groups, all VCA masters then can be lowered, or the input faders of the other channels can be lowered somewhat.



Control voltages from up to 9 different points (the channel fader and 8 VCA master faders) can affect any input channel's VCA gain.

CAUTION

If you assign or deassign an input channel to a VCA master group during a performance, the channel gain will jump up or down unless the corresponding VCA master fader is set precisely to the nominal position (green LED "NOMINAL" indicator illuminated).

8.1.6 Channel muting and gain structure

As pointed out earlier, adding inputs to a mix will increase mix levels. If optimum mix levels are established with some input channels muted, and those channels are later turned on (either with the channel ON switch or through the scene memories), then the bus levels may increase unacceptably, and the levels of all input channels applied to the offending bus or busses may have to be reduced. Similarly, if some groups are added to the stereo master mix after those gains have been calibrated, then stereo bus levels may increase unacceptably, requiring either a reduction in all group master levels or minor adjustments of the stereo master faders.

8.2 Further hints & conceptual notes

8.2.1 What is a VCA, and why is it used?

A VCA, or Voltage Controlled Amplifier, is a special type of amplifier whose gain (the amount of amplification) is adjustable by means of an externally applied DC voltage. This is in contrast to a conventional amplifier, whose effective gain may be adjusted by means of altering a feedback resistance or by attenuating the audio signal before or after the amplifier.

In a conventional console, mixer or other audio processor, a channel fader (or level control) is generally a variable resistor which attenuates the audio signal flowing through it. The fader is usually preceded by a buffer stage and followed by a booster stage, both of which are fixed gain amplifiers. The buffer keeps the fader's changing resistance from loading the input preamplifier, and the booster stage makes up for the fixed insertion loss of the fader resistance when the fader is set to its nominal position (typically 6dB). The signal then may be routed to a submaster (group master) fader, where it is again subject to insertion loss so that some gain must be "made up" by an additional booster amplifier stage. If the signal path becomes complex, with one or more levels of "submaster" control, more noise and distortion can result due to thermal resistor noise and residual amplifier aberrations. Also, because the audio signal must be physically routed over a longer, more involved path, there is more opportunity for crosstalk, electrostatically or electromagnetically induced noise, and further signal quality degradation.

An alternative approach involves the use of a VCA. In the PM3500M, there is one VCA in each input module. That VCA takes the place of the post-fader booster amplifier in a conventional console configuration. The PM3500M channel fader is a variable resistor, but it does not have audio flowing through it. Instead, it adjusts a DC voltage output (from 0 volts at nominal position, to -0.5 volts at maximum gain, to +10 volts at "infinite" attenuation position). The DC output voltage from the channel fader is applied to the channel's VCA control input.

The VCA is a special amplifier that is designed to operate at unity gain when the fader is at nominal position, can provide some gain with the channel and/or VCA master faders set above nominal, but primarily is designed to attenuate the signal as the fader is lowered (you can think of "VCA" as "Voltage Controlled Attenuator", although technically that is a distinctly different device). So far, there is no big advantage to this

VCA approach over the conventional console, where the audio flows through the channel fader.

The VCA's advantage is realized when grouping is used. The VCA master faders are really just like the channel faders in that they output a DC voltage. When one or more input channel VCA assign switches are engaged, the voltage(s) output from the corresponding VCA master fader(s) combine with the channel fader output voltage, and the sum of these voltages determine the channel's VCA gain. The audio signal does not actually flow through any VCA master fader, and no matter how many VCA masters affect the channel, the audio path remains the same—simple and direct with no added noise, distortion or crosstalk.

For reasons described in Section 7.2.2, conventional group master faders are also provided in the PM3500M.

8.2.2 The distinction between the group busses and the VCA master "groups"

The PM3500M provides the operator with two different means to control multiple input channels from a single fader. One approach is to assign multiple inputs to a given group with the group controls [13] (page 14), and to then use the group master fader [52] (page 25) to control those signals. With this approach, the actual audio output signal from each of the assigned input channels is applied to a bus wire via 18K ohm summing/isolation resistors. The signal on the group bus is then fed into a combining (summing) amplifier in the Master module, is routed through the GROUP INSERT IN/OUT jacks [97] (page 33), is then controlled by the group master fader, and is fed to GROUP OUT [102] (page 34) and any other post-group master fader circuits.

An alternativee approach to control multiple input channels from a single fader is to use the VCA system. The audio signal in each input channel does not actually pass through the channel fader [18] (page 16). Instead, that fader applies a DC control voltage to a VCA (Voltage Controlled Amplifier) in the input module. The audio signal flowing through that VCA is, in turn, increased or decreased in level according to the control voltage applied to the VCA. One advantage of the VCA is that the control voltage applied to it can come from more than one point. In fact, when one or more of the input channel's VCA ASSIGN switches [17] (page 16) is engaged, control voltage from the correspondingly numbered VCA master faders [44] (page 23) is also applied to the channel VCA. The circuitry is such that the VCA master will cause the assigned input channel(s) post-fader output levels to ride up and down, scaled to the channel fader setting. Of course, the channel(s) output signal must still be assigned somewhere.

NOTE

It may not seem obvious at first sight, but VCA master faders and VCA assign switches have nothing at all to do with where the routing of the audio signal. They affect only its level. The signal must be assigned via the bus assign controls.

If the signal on several channels is assigned directly to the stereo bus using the channels' stereo assign controls [14] (page 15), then the VCA master to which those channels are assigned will act like a group-to-stereo fader. If the channels' output is assigned to a group bus using a group assign control [13] (page 14), then the VCA master fader [44] (page 23) to which those channels are assigned will control the level applied to the group master fader [52] (page 25), which is somewhat redundant but does serve some useful purposes.

What cannot be done with a group master fader that can be done with a VCA master fader is controlling the post-fader group assign levels from groups of input channels. While it is true that group master faders affect the overall bus output level on the group busses, each of these busses can be considered a discrete output. Of the many input channel controls that may be feeding a given group master fader, some can be controlled by one VCA master, and others by another VCA master. Thus, when "subgrouping" is done using the VCA master faders, the output of affected input channels is controlled more completely. That is, the channels' group and stereo outputs are all affected by the assigned VCA master(s).

What cannot be done with a VCA master fader that can be done with a group master fader is the processing of a single, mixed signal. Consider, for example, that a given group of signals must be compressed—say the backup vocal mics or the drummer's monitor feed. If the several input channels which accommodate backup vocals are all assigned to a single group master fader, then one compressor/limiter can be inserted in the group INSERT IN/OUT patch point [97] (page 33), affecting the mixed signal on that group mixing bus. On the other hand, if those same input channels were instead controlled as a "group" by a VCA master fader, and the channel outputs were assigned to various group mixing busses, then it would be impossible to compress the backup vocal mix. Instead, multiple compressor/limiters would have to be inserted in the individual channel INSERT IN/OUT patch points [88] (page 31). The latter approach is more costly, and also

applies the effect to all the channel's outputs, rather than just to a specific group.

VCA master fader grouping is often useful for control of scenes, songs or sets, whereas conventional group master faders are often useful for control of related groups of mics and instruments. For example, one VCA master might be assigned to control all drum microphones. Another VCA master might also be assigned to the same drum microphones, plus any percussion and guitar mics. One VCA master would then affect drum levels, while the other would affect the entire rhythm section.

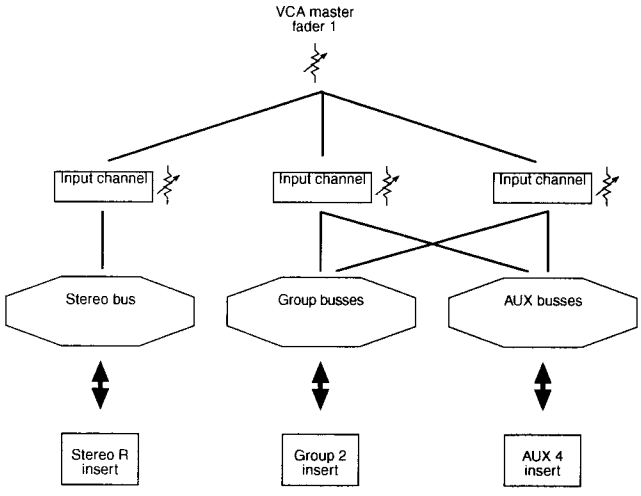
In some cases, multiple channels that are assigned direct to the stereo bus can be controlled in groups by the VCA masters, while other channels can be assigned to different group master faders, and the group masters, in turn, can be assigned to stereo.

There is one further distinction between VCA groups and conventional groups. If one were to use conventional groups to control scenes, sets or songs, a given input channel might well be assigned to several group mixing busses. The Group-to-Stereo assign function would then be used to combine those Group busses to stereo mixes, with the group master faders serving as scene controllers. If, in this instance, two group master faders were raised to nominal position, and the same input channel was assigned to both of those groups, that channel's level could rise 3dB in the combined stereo output, throwing it out of balance with other single-assigned channels. This is because that channel signal is being added together twice in the stereo mix.

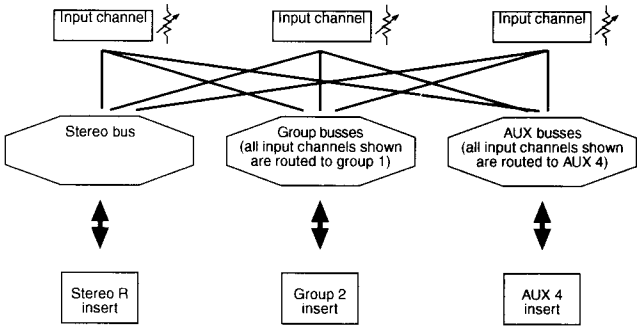
If instead of using conventional group master faders, VCA master faders were used to control the scenes, and one input was assigned to two (or more) VCA masters, the above level "build up" would not occur, and the correct balance would be retained. That's because when VCA master faders are set to nominal position, they output zero volts. This means they don't change the level coming from the input channel. Whether one, two or all eight VCA master faders are assigned to a given input channel, the channel's output level will not change so long as the VCA masters are at nominal.

On the other hand, if one "pulls down" the conventional group master fader in the first example above, the level of the double-assigned input will only drop 3dB, whereas pulling down a VCA master fader will completely kill any input channel assigned to that VCA group.

Ultimately, the selection of VCA or conventional group master fader assignments should be dictated by the specific requirements of the application.



In this example, the input channels and output busses have been selected arbitrarily. The VCA master fader controls the three input channels, and controls their outputs to all the busses (assuming post-fader AUX sends). However, no single INSERT point can process the whole of this VCA-controlled group of inputs.



In this example, the input channels and output busses have been selected arbitrarily. The group 1 master fader controls the post-input fader signals from all of these input channels. In the same way, the AUX 4 master send level fader controls the AUX 4 output from all of these input channels. Using this arrangement, a single effects unit can process the grouped signals if it is placed at the group or AUX insert point.

8.2.3 Using the channel INSERT IN jack as a line input

The input channel INSERT IN jacks [88] (page 31) are electronically balanced, line level inputs that come after the channel PAD switch and GAIN control. These jacks may be used to accommodate any balanced or unbalanced +4dBu nominal line input source. Why would one want to use the 1/4" phone jack INSERT IN rather than the XLR channel input? There are several possibilities. Certainly, the most obvious is that if the input source is equipped with a +4dBu phone jack output, then the INSERT IN jack enables a standard phone plug-to-phone plug cable to be used without any adaptor. However, the INSERT IN jack also can save time.

If the PM3500M is being used for theatre production or TV production, then CD or tape machine returns (playback from the CD machine or tape recorder) can be plugged into the INSERT IN jacks, while microphones or other line level sources can be plugged into the channel XLRs. When recording the tracks or using live mics for other purposes, the channels' PAD switches and GAIN controls can be set, as needed, for the various input sources. When playing back a CD or tape, the PAD switches and GAIN controls need not be readjusted; instead, simply engage the channel INSERT ON switches [10] (page 13) to select the recorded material. The same concept applies where the console is used for multiple stage setups (as in subsequent scenes in a theatrical presentation, or different sets for a live musical show). Provided one of the sources is a +4dBu line level source, it can be connected to the INSERT IN, and the other mic or line level source can be connected to the channel XLR; the INSERT switch then permits instantaneous selection of one or the other input source without need to disconnect and connect cables.

9 Applications

9.1 General applications

Although the PM3500M has been designed primarily for audio mixing of stage monitor systems in live sound reinforcement applications, it is flexible enough to be used in other applications as well: theatrical and TV production, and even as the primary "house mixer" in certain situations. We explain a few reasons below why the PM3500 is well suited to these applications, but, rather than focus on specific en-user applications, we feel it is more important to point out how some of the PM3500 sub-systems can be used to accomplish specific mixing tasks. It is up to you, as the sound engineer or mixing console operator, to use these capabilities to their best advantage in your specific situation. This manual cannot, by the nature of things, be fully comprehensive, and we expect that many users will devise unique means to connect and use the PM3500. In fact, we at Yamaha encourage you to share these special applications with us, so that we may, in turn, share the general concepts with other PM3500 users.

The following pages present specific examples, with descriptive text on the left page and an explanatory diagram on the right.

9.2 The "Super band" input source list

Some of the following application diagrams and descriptions are based on mixing a large number of sources from a band (or from separate bands). To avoid repeating this source list several times, we feel it appropriate to show a representative list of mic- and line-level audio sources for a large popular music band. If we use a term in a later part of this section, please refer to this list. Note that there are also some suggestions made as to the use of various signal processors to be inserted in the INSERT loop of some channels, but these should be regarded as examples (albeit based on practical usage) rather than as hard and fast "musts".

Ch.	Input source	Insert processor
1	Kick 1	Compressor
2	Kick 2	Compressor
3	Snare top	Compressor
4	Snare bottom	Compressor
5	Hi-hat	Gate
6	Rack tom 1	Gate
7	Rack tom 2	Gate
8	Rack tom 3	Gate
9	Rack tom 4	Gate
10	Floor tom	Gate
11	Overhead SR	Gate
12	Overhead SL	Gate
13	Percussion SL overhead	Gate
14	Percussion SR overhead	Gate
15	Conga SR	Gate
16	Conga SL	Gate
17	Toys	Gate
18	Chimes	Gate
19	Timbales	Gate
20	Keys SL Left	—
21	Keys SL Right	—
22	Keys SR Left	—
23	Keys SR Right	—
24	Piano high	—
25	Piano low	—
26	Bass (direct in)	Compressor
27	Bass (miked)	Compressor
28	Lead guitar L	—
29	Lead guitar R	—
30	Rhythm guitar L	—
31	Rhythm guitar R	—
32	Tenor sax	—
33	Baritone sax	—
34	Trumpet	—
35	Trombone	—
36	Lead vocal 1	Compressor
37	Lead vocal 2	Compressor
38	Lead vocal 3	Compressor
39	Backing vox 1	—
40	Backing vox 2	—
41	Backing vox 3	—
42	Backing vox 4	—
43	Backing vox 5	—
44	Backing vox 6	—
45	Effect return 1 L	—
46	Effect return 1 R	—
47	Effect return 2 L	—
48	Effect return 2 R	—
49	Effect return 3 L	—
50	Effect return 3 R	—
51	Effect return 4 L	—
52	Effect return 4 R	—

9.2.1 Stage monitor mixing

In a stage monitoring system where performers listen to individually-tailored mixes via loudspeakers, the PM3500M offers many benefits. The eight group outputs and the stereo outputs can be used to provide five discrete stereo monitor mixes. In addition to this, the matrix gives much more flexibility to the monitoring engineer; four additional stereo and four additional mono mixes are also available.

This large number of output facilities allows you to set up many different monitoring submixes — the keyboard player and drummer can each have their own sidefill mixes, in addition to the main stage sidefill mixes. A separate stereo mix can even be set up for the on-stage lighting and effects crews.

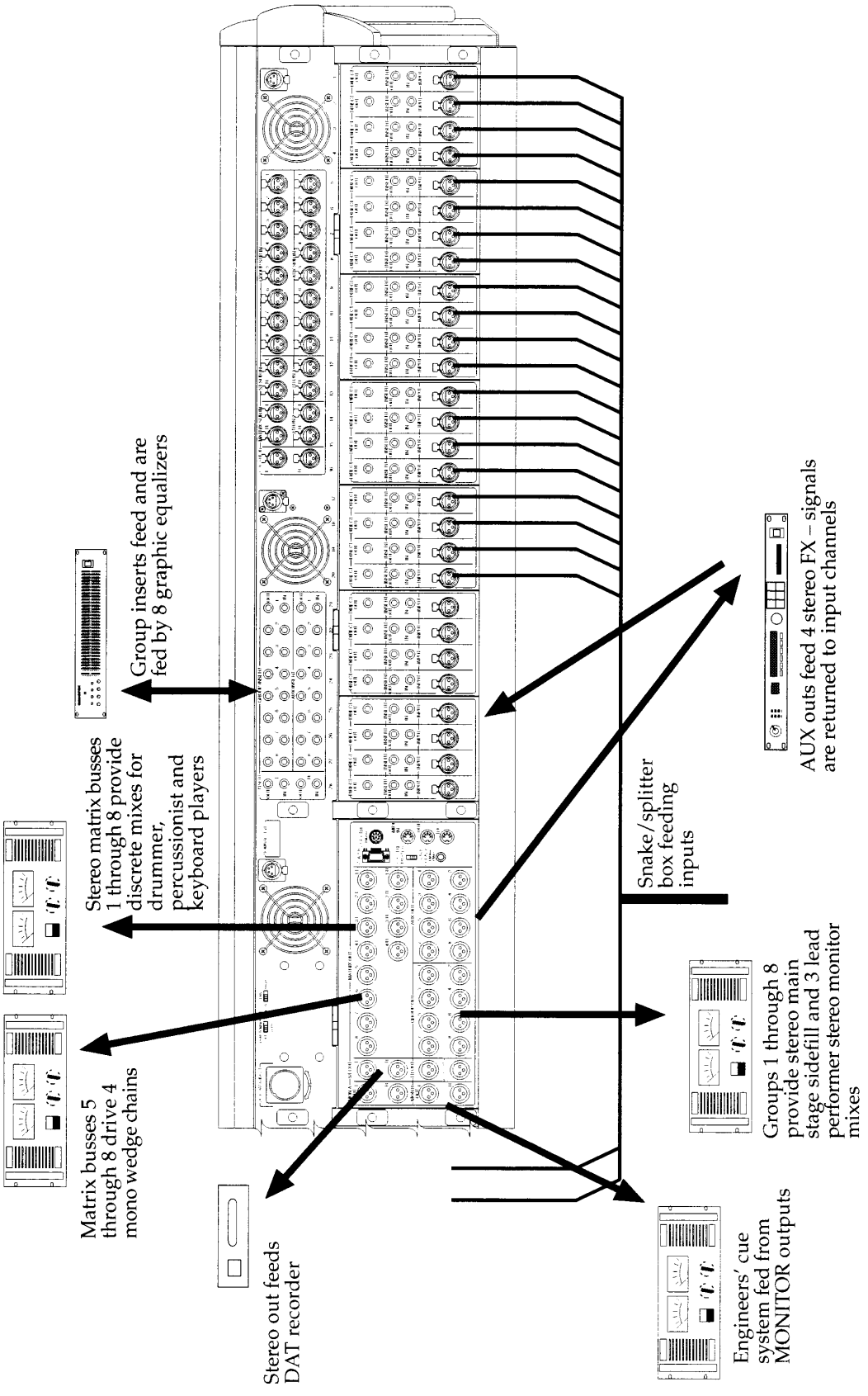
The extra monaural groups can be used to feed wedges or other monitoring systems around the staging area, including bi-amped crossover networks.

Since the group outputs all have insert points, it is possible to connect offboard processors such as graphic equalizers and/or dynamic processors such as compressors or noise gates in each monitor mix fed by these groups ahead of the group fader. This is an advantage, as any noise contributed by the processor will be attenuated when the bus fader is pulled down. If the processor were in line with the bus and the speaker amplifier, this would not be the case. This makes for a much quieter monitor mix. Another important point is that level-dependent processors (such as compressors and gates) should be independent of the bus fader position, so it is important to use the insert loops with these processors.

Again, the individual channel insert points are invaluable for applying a particular processor to a particular input. Comp/limiters, delays, etc. or parametric equalizers to handle equalization problems that even the PM3500M's equalization cannot cope with are some of the devices which you may want to insert here. Channels can have the insert point moved from post-EQ to pre-EQ – see the Optional Features section for details.

Another use for the insert points is to allow two independent inputs to share one channel. A phone jack can be connected to the insert IN of a channel, which, when the INSERT is on ([10] (page 13)) will replace the input feeding the channel's XLR input. If a set is being mixed with two bands, one with many keyboards, and one with many miked acoustic sources, this is a way of using the PM3500M for both sets without repatching between sets.

The INSERT switch can also be used to punch effects in and out dynamically by channel, avoiding the thumps and transients which might otherwise occur when switching an effect on or off.


Group inserts feed and are fed by 8 graphic equalizers
Stereo matrix busses 1 through 8 provide discrete mixes for drummer, percussionist and keyboard players
Matrix busses 5 through 8 drive 4 mono wedge chains
Stereo out feeds DAT recorder
Snake/splitter box feeding inputs
AUX outs feed 4 stereo FX – signals are returned to input channels
Groups 1 through 8 provide stereo main stage sidefill and 3 lead performer stereo monitor mixes
Engineers' cue system fed from MONITOR outputs

9.2.2 Wireless stage monitoring

Though the cost of wireless stage monitoring is expensive, these systems are becoming increasingly popular. Formerly restricted to leading acts (or at least lead performers in a leading act), their use is spreading. As the cost of such systems comes down, we can expect to see more such systems in common use in the future, and accordingly a few notes regarding wireless monitoring and its application with the PM3500M are in order here.

A wireless monitor system generally consists of a stereo transmitter at the monitor mixing console, a discreet portable stereo receiver carried by the performer, and a set of headphones or earphones to convey the received audio to the performer's ears. Often the earphones are custom-molded to the performer's ear canals and can therefore exclude other sounds completely. This can preserve the performer's hearing, even in the middle of extremely intense sound fields, provided that the system is properly designed and deployed.

An additional advantage is that a primary source of feedback is eliminated, allowing a higher gain-before-feedback level in the house mix. The house mix is also more uncolored, since on-stage monitor spillover is eliminated. A good design for a wireless feedback system will include carefully-designed compression to prevent extremely loud transients, especially at low frequencies, from reaching the eardrums.

WARNING

Never attempt to use any transmitter/receiver/transducer combination for this application unless it is specifically designed for wireless monitoring. To do otherwise is to risk permanent damage to the user's hearing.

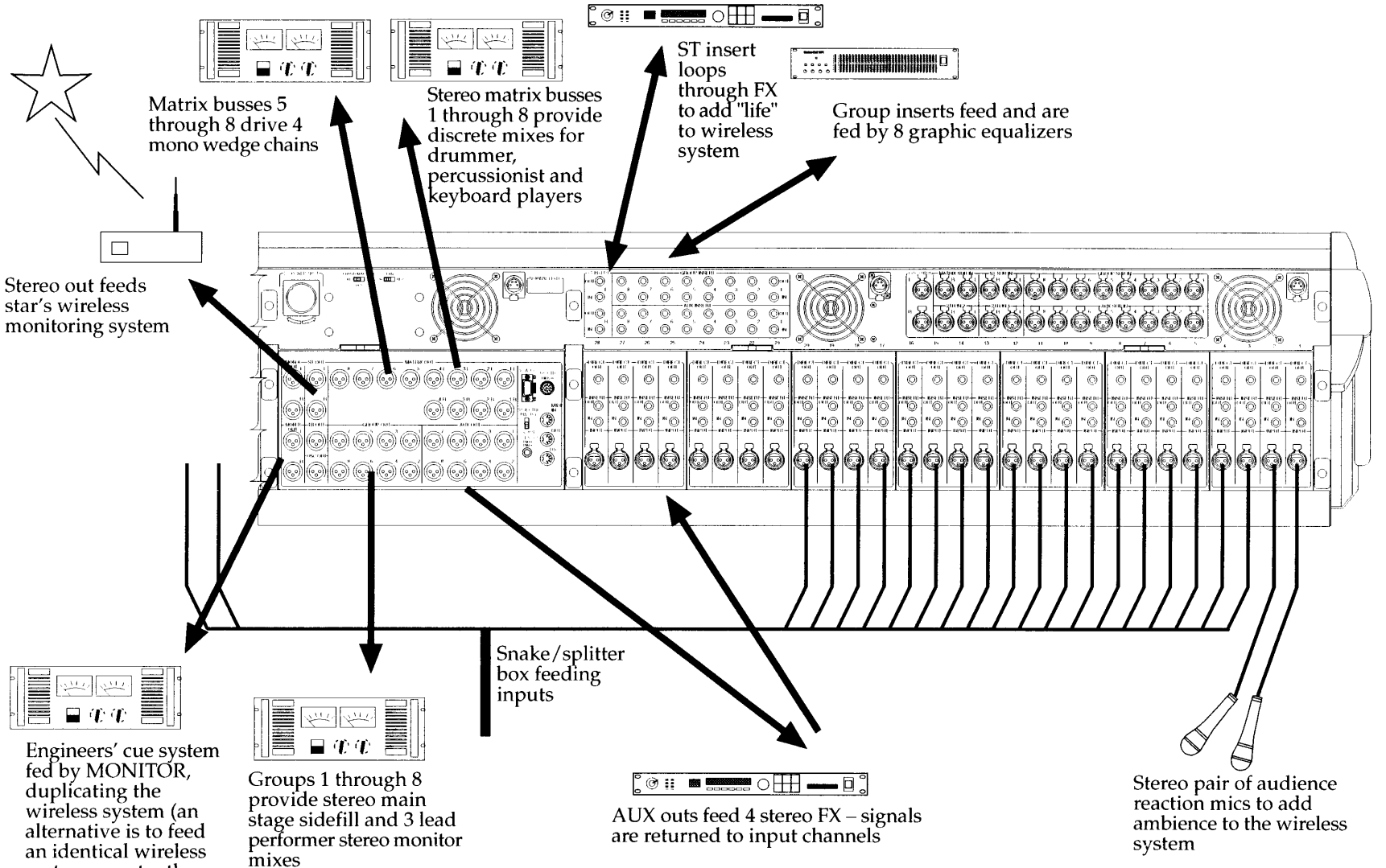
Other than the advantages to the operators (reduced feedback, etc.) the advantages to the performer are also considerable: a solo vocalist or performer moving round the stage (or even round the venue) can enjoy a constant monitor reference source, rather than one which is affected by constantly changing acoustics and relative positions to the speakers. A possible downside is that since external sounds are attenuated, the performer is unable to hear audience reaction so easily, and it may therefore be necessary to feed in a more ambient mix (possibly including audience response from a pair of microphones).

The PM3500M allows the creation of a number of high-quality stereo mixes, from the stereo bus, from the group busses and from the stereo matrix group busses. In a real world situation, it is unlikely that all monitoring will be wireless, so it is possible to set up a mixture of wireless and speaker mixes from the extensive range of options available with the PM3500M.

WARNING

When using wireless systems, it is more important than ever that effect returns are not looped back into a bus which is sending to that effect. The result will be feedback and possible hearing damage to the user of the wireless system. Use colored tape to mark off the "off limits" busses so that no-one will accidentally make this routing.

Of course, the increased isolation of the performer and the reduced coloration of the monitor mix will make the performer even more critical and demanding of the monitor mix. The PM3500M's superior sonic performance makes it easy for the engineer to achieve that goal. Additionally, the engineer needs more than ever before to monitor the signal sent to the performer. In this case, a near-field high-quality monitor speaker/amp system (for instance, Yamaha NS-10m speakers) can be set up and connected to the MONITOR A or B bus, monitoring the STEREO buss output, which feeds the star's wireless monitoring system. The level on the MONITOR buss can be turned up and down as appropriate, and headphones can be used for more traditional CUE tasks.


Matrix busses 5 through 8 drive 4 mono wedge chains
Stereo matrix busses 1 through 8 provide discrete mixes for drummer, percussionist and keyboard players
ST insert loops through FX to add "life" to wireless system
Group inserts feed and are fed by 8 graphic equalizers
Stereo out feeds star's wireless monitoring system
Snake/splitter box feeding inputs
Engineers' cue system fed by MONITOR, duplicating the wireless system (an alternative is to feed an identical wireless system, constantly monitored by the engineers)
Groups 1 through 8 provide stereo main stage sidefill and 3 lead performer stereo monitor mixes
AUX outs feed 4 stereo FX – signals are returned to input channels
Stereo pair of audience reaction mics to add ambience to the wireless system

9.3 Using the PM3500M in a theatrical application

Although the PM3500M is primarily designed as a monitoring console, the large number of output groups and the matrix make it especially suitable for use in a theatrical sound reinforcement capacity. The high gain figures mean that distant microphones and quiet speaking voices present no problems.

The scene memories allow selective muting of groups of microphones, and the MIDI Program Change messages sent by the PM3500M can even be used to trigger MIDI-controlled lighting rigs. Alternatively, musical sequencers can trigger scene changes in the PM3500M. The VCA facilities are also especially suitable for the control of overlapping groups of inputs for "additive" and "subtractive" fades in a way that is difficult to achieve with traditional groupings methods.

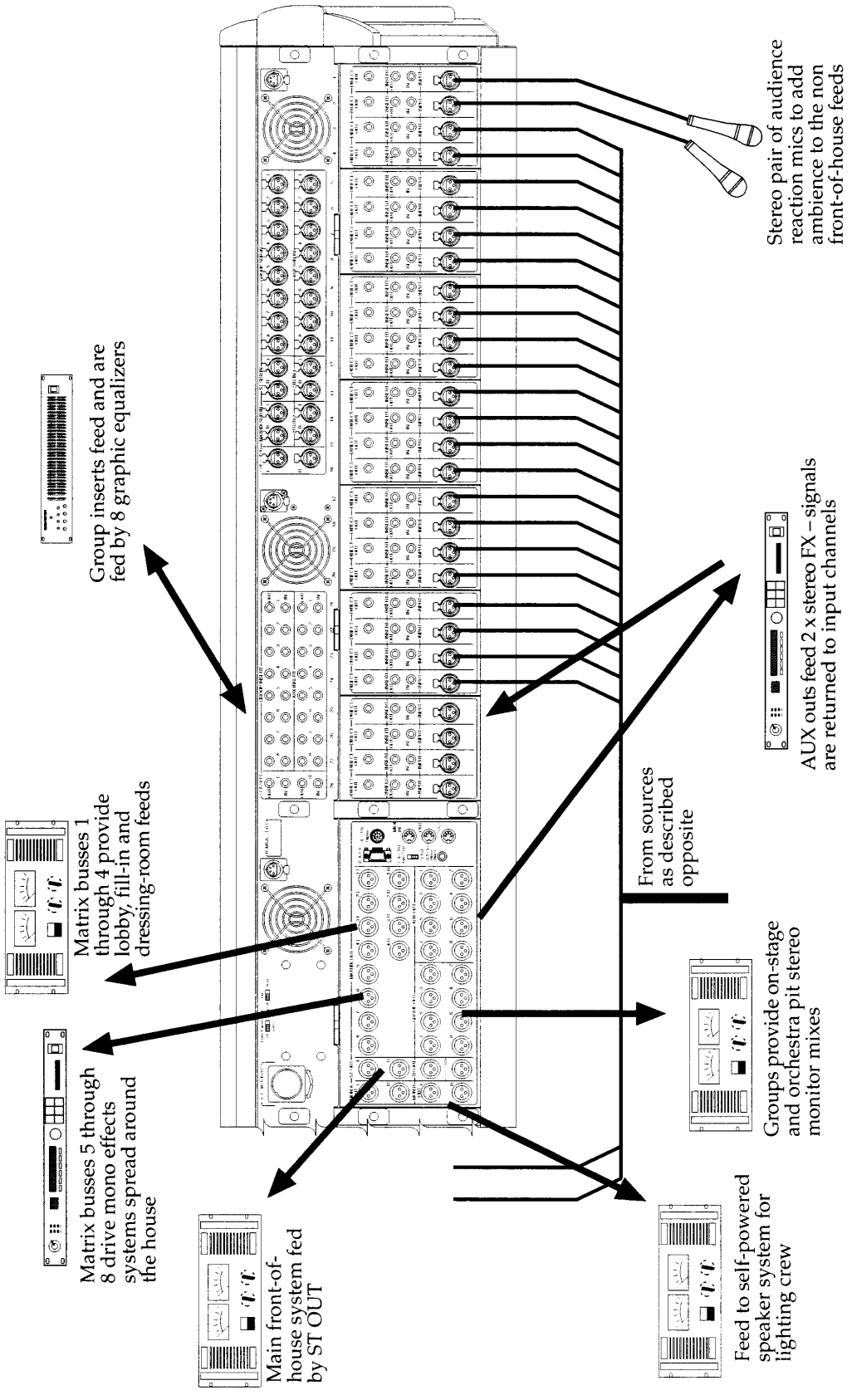
The main stereo outputs can be used to drive the main front-of-house system, and the stereo matrix groups can be used to provide additional stereo feeds to fill-in pairs, lobby, dressing rooms, or even to a tape or OB. These non front-of-house feeds will also have a stereo pair of audience reaction mic feeds added.

For strategic location of sound effects to appear from round the house (wings, balcony, under-balcony, etc.), the groups and/or mono matrix groups can be used.

The channel INSERT points are extremely useful for adding effects to individual input channels (special effects on one character's voice, for example) without sacrificing master AUX loops. The INSERT switch on each channel can be used to bring these in and out of play at the appropriate times. The group INSERT points allow group compression, gating, equalization, etc. for specific groups of microphones or input signals.

Since the PM3500M has a center master configuration, with two sets of headphones, two engineers can work together (say one for music and another for speech and FX) without getting in each other's way. The two monitor outputs allow for two separate sets of speakers (perhaps one for the lighting staff) to be used. In addition, the PM3500M's low profile gives better sightlines when installed in, say, a balcony, and takes up fewer seats than other consoles of comparable capacity. If the production is to go on tour, the PM3500M's rugged construction and modular approach make it an ideal touring partner. The following table shows possible channel assignments for a large musical production (a Broadway or West End musical).

Ch.	Input source	Insert processor
1	Announcer	Compressor
2	RF Mic 1	Gate
3	RF Mic 2	Gate
4	RF Mic 3	Gate
5	RF Mic 4	Gate
6	RF Mic 5	Gate
7	RF Mic 6	Gate
8	RF Mic 7	Gate
9	RF Mic 8	Gate
10	RF Mic 9	Gate
11	RF Mic 10	Gate
12	RF Mic 11	Gate
13	RF Mic 12	Gate
14	Effect return 1 L	—
15	Effect return 1 R	—
16	Effect return 2 L	—
17	Effect return 2 R	—
18	Tape 1 L	NR
19	Tape 2 R	NR
20	Audience reaction L	—
21	Audience reaction R	—
22	CD player 2 L	—
23	CD player 2 R	—
24	Tap Mic 1	Gate + FX
25	Tap Mic 2	Gate + FX
26	Tap Mic 3	Gate + FX
27	Tap Mic 4	Gate + FX
28	Orchestra	Signal processing as required on orchestral inputs
29	Orchestra	
30	Orchestra	
31	Orchestra	
32	Orchestra	
33	Orchestra	
34	Orchestra	
35	Orchestra	
36	Orchestra	
37	Orchestra	
38	Orchestra	
39	Orchestra	
40	Orchestra	
41	Orchestra	
42	Orchestra	
43	Orchestra	
44	Orchestra	
45	Orchestra	
46	Orchestra	
47	Orchestra	
48	Orchestra	
49	Orchestra	
50	Orchestra	
51	Orchestra	
52	Orchestra	


Stereo pair of audience reaction mics to add ambience to the non front-of-house feeds
Group inserts feed and are fed by 8 graphic equalizers
AUX outs feed 2 x stereo FX – signals are returned to input channels
Matrix busses 1 through 4 provide lobby, fill-in and dressing-room feeds
From sources as described opposite
Matrix busses 5 through 8 drive mono effects systems spread around the house
Groups provide on-stage and orchestra pit stereo monitor mixes
Main front-of-house system fed by ST OUT
Feed to self-powered speaker system for lighting crew

9.4 TV production (general)

With the number of live music, special effects, pre-corded sources and close microphone techniques employed in today's TV productions, sophisticated sounds is more and more essential to successful video production. The increase in popularity of music videos and the improvement in the quality of sound reproduction from video equipment also reinforce this trend.

The PM35000M is particularly suitable for this kind of production, given the large number of inputs, grouping facilities, and output groups (including the matrix). The VCA groups can also be used to make "additive" and "subtractive" group fades.

Sub-mixers, etc. can also be used to help expand the capability of the PM3500M, and with the extensive range of SUB INs, the maximum of 52 input channels can be expanded easily. Group SUB inputs can be used to add "sweetening" sources to the groups, freeing up input channels.

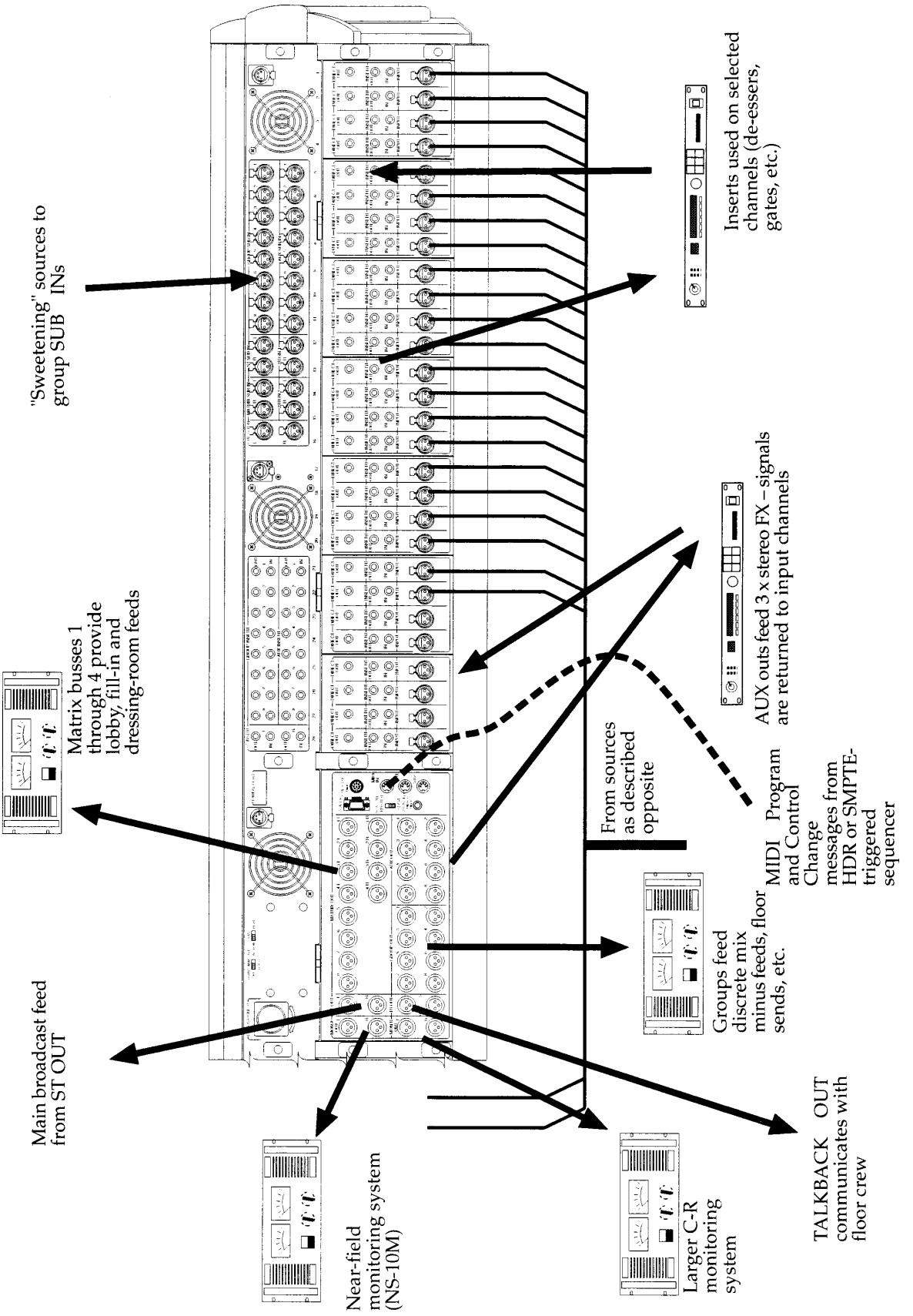
The eight group busses can be used for single-fader adjustment of groups of sources (instruments, mics, effects, etc.) and these can be further submixed using the matrix for on-set monitoring purposes (including dressing rooms, etc.). Assignment of the group busses to the stereo bus allows the stereo bus to be used as a "grand master" feeding the final broadcast feed (be it a digital master or a live feed). Alternatively, the groups can be used to feed discrete mix minus feeds, floor sends, effect sends (in addition to the AUX sends), etc.

Since the input channels incorporate full 4-band equalization, there is no need for a rack of offboard parametric equalizers. The variable HPFs on each channel can help with breath and microphone pops, and specific offboard effects (e.g. de-essers) can be patched into the channels' inserts where required.

The MIDI scene change capabilities can be used to enormous advantage when used in combination with a disk recorder capable of sending MIDI Program or Control Change messages synced to SMPTE time code, muting all mic groups except for the announcer's voiceover when playing soundbites, for example. The dedicated talkback out connector allows communication with the crew, duplicating, or supplementing the intercom system.

Dual monitor outputs allow both large and near-field monitoring systems to be set up in the control-room, and A-B comparisons to be made easily. The table shows a complex TV production, which can be handled easily with the PM3500M's capabilities.

Ch.	Input source	Insert processor
1	Announcer	Compressor
2	VT "A" L	Limiter
3	VT "A" R	Limiter
4	VT "B" L	Limiter
5	VT "B" R	Limiter
6	VT "X" L	Limiter
7	VT "X" R	Limiter
8	VT "Y" L	Limiter
9	VT "Y" R	Limiter
10	ATR L	NR
11	ATR R	NR
12	Cart/CD 1 L	Limiter
13	Cart/CD 1 R	Limiter
14	Cart/CD 2 L	Limiter
15	Cart/CD 2 R	Limiter
16	DAT/HDR L	—
17	DAT/HDR R	—
18	RF 1	Signal processing (de-essers, etc. as required)
19	RF 2	
20	RF 3	
21	RF 4	
22	RF 5	
23	RF 6	
24	RF 7	
25	RF 8	
26	P1	
27	P2	
28	P3	
29	P4	
30	P5	
31	P6	
32	Podium1 A	Gate and compressor
33	Podium 1 B	Gate and compressor
34	Podium 2 A	Gate and compressor
35	Podium 2 B	Gate and compressor
36	AR 1	—
37	AR 2	—
38	AR 3	—
39	AR 4	—
40	AR 5	—
41	AR 6	—
42	AR 7	—
43	Satellite feed 1 L	Limiter
44	Satellite feed 1 R	Limiter
45	Satellite feed 2 L	Limiter
46	Satellite feed 2 R	Limiter
47	Effect return 1 L	—
48	Effect return 1 R	—
49	Effect return 2 L	—
50	Effect return 2 R	—
51	Effect return 3 L	—
52	Effect return 3 R	—


"Sweetening" sources to group SUB INs
Inserts used on selected channels (de-essers, gates, etc.)
Matrix busses 1 through 4 provide lobby, fill-in and dressing-room feeds
AUX outs feed 3 x stereo FX – signals are returned to input channels
From sources as described opposite
Main broadcast feed from ST OUT
Groups feed discrete mix minus feeds, floor sends, etc.
MIDI Program and Control Change messages from HDR or SMPTE-triggered sequencer
Near-field monitoring system (NS-10M)
Larger C-R monitoring system
TALKBACK OUT communicates with floor crew

9.5 TV Sports production (golf)

The production of TV sports requires a large number of report microphone inputs, as well as inputs from camera mics, guests, and remote (satellite) feeds). Here we take a golf match as an example of an OB sports event with complex camera assignments.

The coverage of a golf match (as with many sporting events) demands much instant replay, and therefore the large number of busses from the groups and matrix can be used to provide ISO tape feeds which can be patched through the routing switcher.

The matrix can also be used to provide pre-listen feeds to reporters and commentators scattered round the course, allowing accurate cueing of these feeds by the centrally-located producer.

The group bus insert points allow dynamic processing of the group outputs, which reduces the need for comp/limiters on every microphone input. Of course, the channel insert points are still available should one particular microphone require particular treatment.

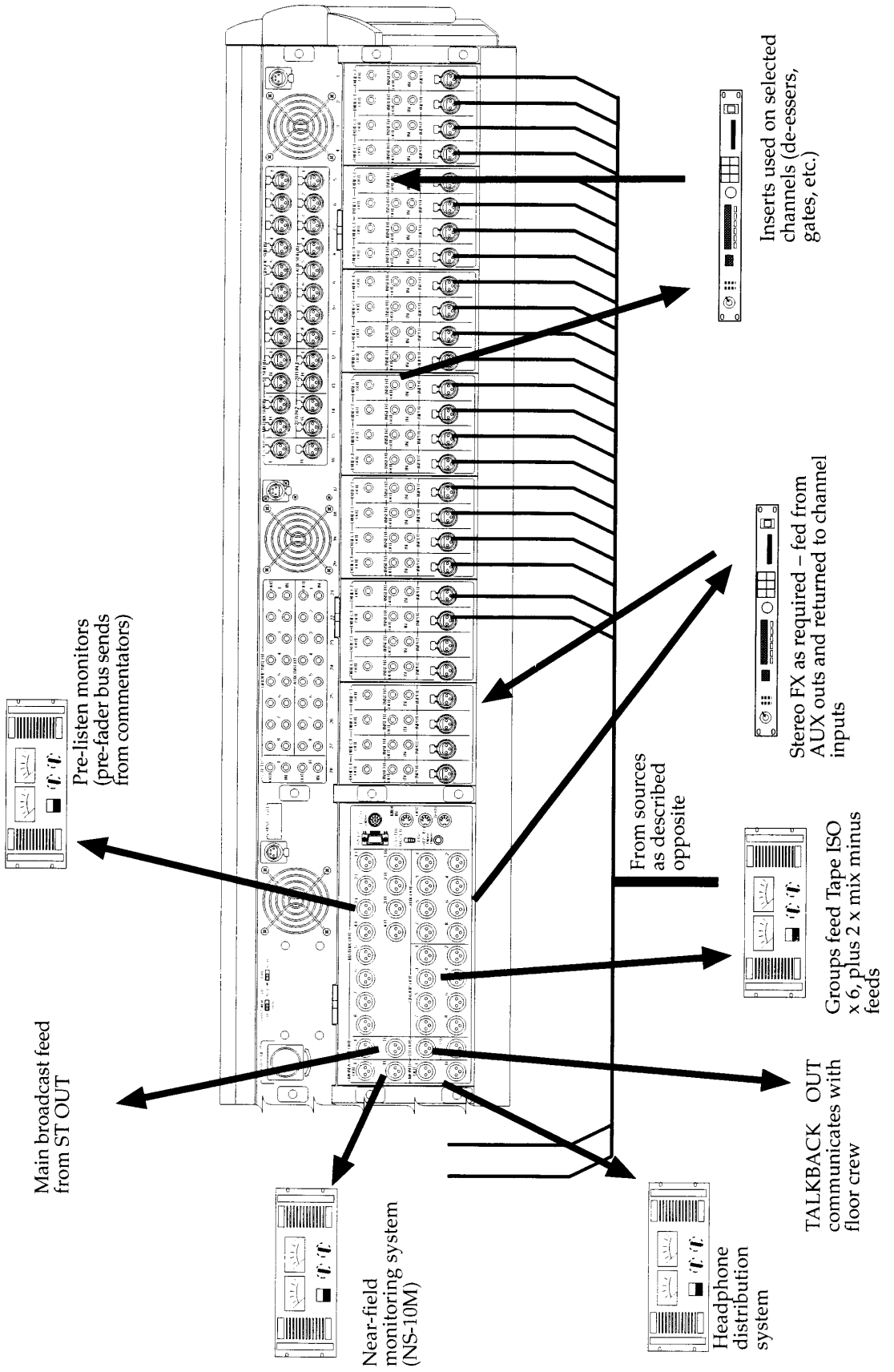
The stereo bus is used to output the main program feed, and a dynamic processor can be inserted in the stereo bus insert loop prior to transmission.

Since there are two monitor systems, one can be used for control-room monitor speakers, and the other for any headphone distribution system in use (the PM3500M's own headphone system is independent of these two).

With this setup, 33 microphones have been allocated for this golf match (covering only the last 5 holes!).

Other sporting events (soccer, football, basketball, etc. will impose their own requirements on the sound engineers, but the PM3500M's flexibility allows it to be taken anywhere and reconfigured to meet the needs of the situation. In this context, the modular nature of the PM3500M also means that spare parts can be field-swapped in the rare event of component failure.

Ch.	Input source	Notes
1	Hole 14 tee	Par 4
2	Hole 14 fairway 1	
3	Hole 14 fairway 2	
4	Hole 14 green	
5	Hole 15 tee	Par 3
6	Hole 15 fairway	
7	Hole 15 green	
8	Hole 16 tee	Par 3
9	Hole 16 green	
10	Hole 17 tee	Par 4
11	Hole 17 fairway 1	
12	Hole 17 fairway 2	
13	Hole 17 green	
14	Hole 18 tee	Par 3
15	Hole 18 green	
16	Camera mic 1	
17	Camera mic 2	
18	Camera mic 3	
19	Camera mic 4	
20	Camera mic 5	
21	Camera mic 6	
22	Camera mic 7	
23	Camera mic 8	
24	18th hole stick mic 1	
25	18th hole stick mic 2	
26	RF mic 1 (roving)	
27	RF mic 2 (roving)	
28	Commentator	Booth mics
29	Color	
30	Guest	
31	Spare	
32	Stick 3	
33	Stick 4	
34	VTR A audio	
35	VTR A effects	
36	VTR B audio	
37	VTR B effects	
38	VTR X audio	
39	VTR X effects	
40	VTR Y audio	
41	VTR Y effects	
42	Betacam audio	
43	Betacam effects	
44	ATR L	
45	ATR R	
46	DAT L	
47	DAT R	
48	Cart 1	
49	Cart 2	
50	Satellite input	
51	CD L	
52	CD R	—


Main broadcast feed from ST OUT
Pre-listen monitors (pre-fader bus sends from commentators)
Near-field monitoring system (NS-10M)
Headphone distribution system
TALKBACK OUT communicates with floor crew
Groups feed Tape ISO x 6, plus 2 x mix minus feeds
From sources as described opposite
Stereo FX as required – fed from AUX outs and returned to channel inputs
Inserts used on selected channels (de-essers, gates, etc.)

9.6 House of Worship application

In a sound reinforcement application for a house of worship, the PM3500M is especially suitable. In an application like this, many inputs are needed for ministry, choirs, speakers, instruments, etc., and many different outputs: primary sound reinforcement, VTR or audio tape recorder feeds, monitoring for musicians, and closed-loop systems for the hearing-impaired members of the congregation.

The scene memories of the PM3500M are ideal for this kind of application. Different scenes can be made up: the "unaccompanied choir", "sermon", "concert", "testimony" scenes for example. Each of these can be recalled instantly, allowing the whole of the choir and instrumental mics to be muted during the sermon, for instance. Group inserts can be used for the treatment of similar groups of signals, cutting down the number of gates, required, for example.

The PM3500's high gain figures are especially suitable for reinforcing the voices of those unfamiliar with the system (visiting preachers), for children's dramatic presentations, or those who are somewhat hesitant about speaking in public.

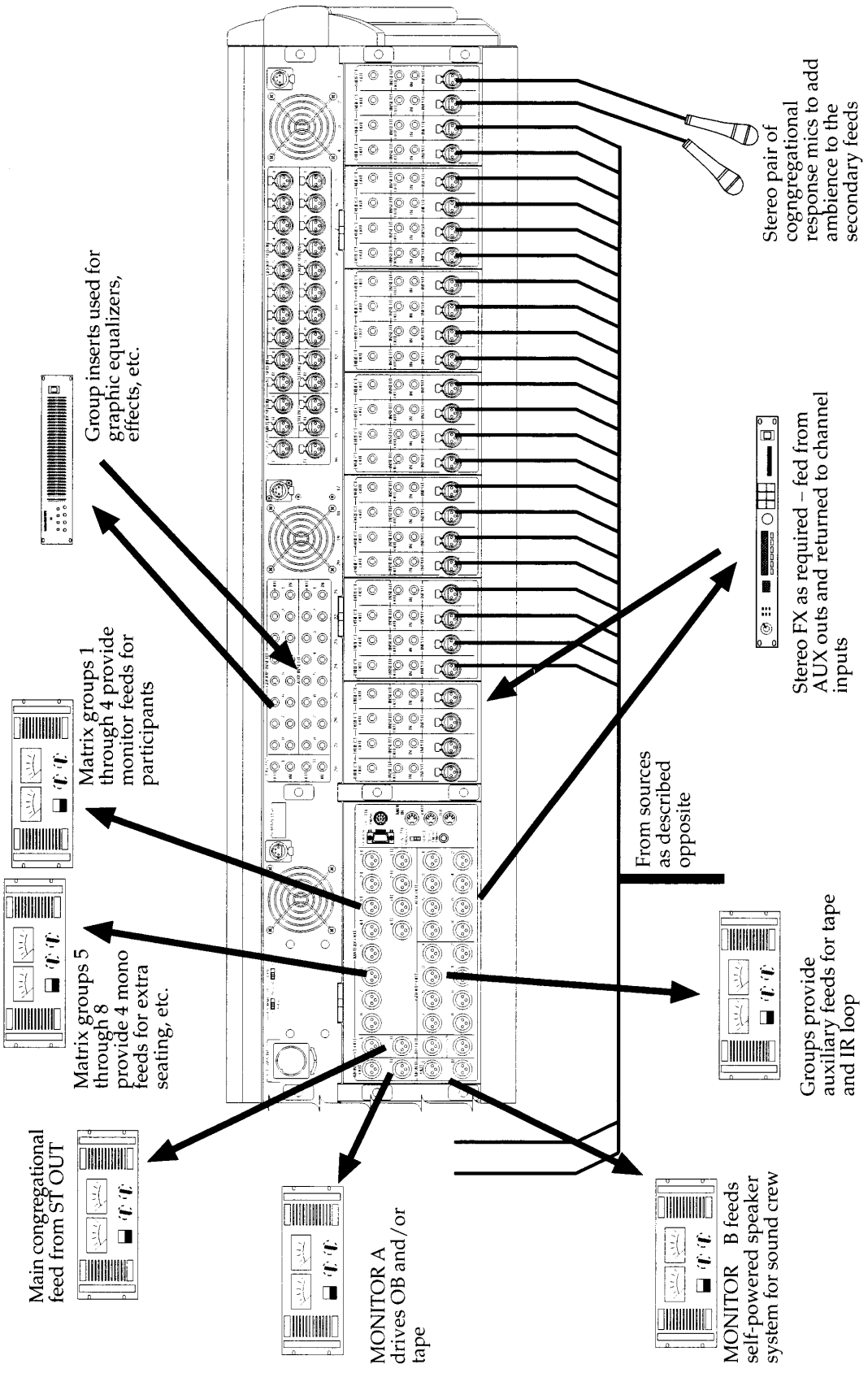
The matrix groups can be used to drive different feeds (recordings of the service and the hearing-impaired circuit, for instance) while cutting them out of the main stereo reinforcement (a pipe organ would be a suitable candidate for this treatment).

Additional feeds (to overflow halls, etc.) can be easily created using the matrix.

Given the 8 groups and the matrix, it is also possible to set up a range of different monitoring mixes for different participants (the organist, for instance, will need a different set of cues to those required by a drummer in an orchestra or band) without the need for a dedicated monitor console and console operator on stage.

The PM3500M's dual-operator configuration makes it easy to use in these applications, and the low profile allows good visibility to a large number of the congregation.

Ch.	Input source	Insert processor
1	Reverb return 1 L	Gate
2	Reverb return 1 R	
3	Reverb return 2 L	
4	Reverb return 2 R	
5	Reverb return 3 L	
6	Reverb return 3 R	
7	Reverb return 4 L	
8	Reverb return 4 R	
9	Pipe organ 1	Not fed to congregation, but fed to tape and hearing-impaired feeds
10	Pipe organ 2	
11	Pipe organ 3	
12	Pipe organ 4	
13	Pipe organ 5	
14	Pipe organ 6	
15	Pipe organ 7	
16	Pipe organ 8	
17	CD L	
18	CD R	
19	ATR L	
20	ATR R	
21	Podium 1 A	Compressor and/or de-esser
22	Podium 1 B	
23	Podium 2 A	
24	Podium 2 B	
25	Podium 3 A	
26	Podium 3 B	
27	RF 1	Gate
28	RF 2	
29	Soloist 1	Compressor
30	Soloist 2	
31	Choir	Signal processing as required by each input source
32	Choir	
33	Choir	
34	Choir	
35	Choir	
36	Choir	
37	Choir	
38	Choir	
39	Choir	
40	Choir	
41	Orchestra / band	
42	Orchestra / band	
43	Orchestra / band	
44	Orchestra / band	
45	Orchestra / band	
46	Orchestra / band	
47	Orchestra / band	
48	Orchestra / band	
49	Orchestra / band	
50	Orchestra / band	
51	Orchestra / band	
52	Orchestra / band	


Main congregational feed from ST OUT
Matrix groups 5 through 8 provide 4 mono feeds for extra seating, etc.
Matrix groups 1 through 4 provide monitor feeds for participants
Group inserts used for graphic equalizers, effects, etc.
MONITOR A drives OB and/or tape
MONITOR B feeds self-powered speaker system for sound crew
From sources as described opposite
Groups provide auxiliary feeds for tape and IR loop
Stereo FX as required – fed from AUX outs and returned to channel inputs
Stereo pair of cogngregational response mics to add ambience to the secondary feeds

9.7 Concert "house" mixing

Although the PM3500M is not specifically designed for front-of-house mixing (this is the purpose of the PM3500) there are times when the flexibility and features of the PM3500M can make it a suitable front-of-house console.

For instance, having two consoles, one for reinforcement and one for monitoring, is expensive both in terms of money and in terms of space taken up by the consoles. Since the PM3500M is designed for two-operator operation, the console can take its place as a dual function console, with one operator being responsible for the reinforcement sound, and the other for the monitor mixes.

If the groups are to be used as monitor bus feeds, the group insert points are useful here; graphic equalizers and/or dynamic processors such as compressor/limiters and noise gates can be connected. The group fader then attenuates any noise contributed by these devices, giving a much quieter mix.

Alternatively, the mix matrix can be used to provide monitor mixes (stereo and mono) from the groups. This may prove to be a more satisfactory method of working than using the groups.

The scene memories may be particularly useful when mixing for a large number of smaller acts (for instance a folk festival) where different groups of inputs can be assigned in the sound check and brought into play as the acts appear on stage or add or subtract instruments from their lineup. Here, the VCAs may also be useful to raise or lower the level of channels assigned to groups.

Although each input channel is capable of only processing one input at a time, it is possible to use the INSERT IN as an auxiliary input (if the insert loop is not being used for effect processing). The same channel could therefore be used for a miked acoustic instrument in one set and a directly-injected electronic instrument in another, simply by using the insert switch. Alternatively, the phone jack could be used for a background music source to be played between sets and "punched out" in the performance by use of the insert switch.

The talkback facility can be used for between-sets announcements, etc. without having to dedicate an input channel for this purpose.

If a recording of the performance is required, it is easy to set up a feed to a tape deck, etc. using the matrix or a pair of groups.

One particularly interesting application of the PM3500M is for special effects. With the continuously variable send of each channel's level to the groups, it is possible to create multi-dimensional panning effects easily on the OM3500M which would be more complex to achieve on more traditional sound-reinforcement consoles.

For a rental or touring company with high sonic requirements, and demands for flexibility, but without an unlimited budget, the PM3500M is worth considering as a dual-purpose console. Obviously, the PM3500 sound reinforcement console and the PM3500M monitoring console is an ideal setup, but budgetary constraints do not always allow such a setup.

There is no diagram given for this kind of use of the PM3500M – the range of potential applications and configurations is too great. Suffice it to say that with a little imagination, the PM3500M can be made to do the work of several, less flexible, console.

9.8 Linking consoles

The PM3500M provides up to 52 input channels. Though this may seem a lot (and is enough for many, indeed most, applications), there are times when 52 inputs are simply not enough. You may never be called upon to do the sound for an extravaganza such as the Academy Awards Show, but you never know...

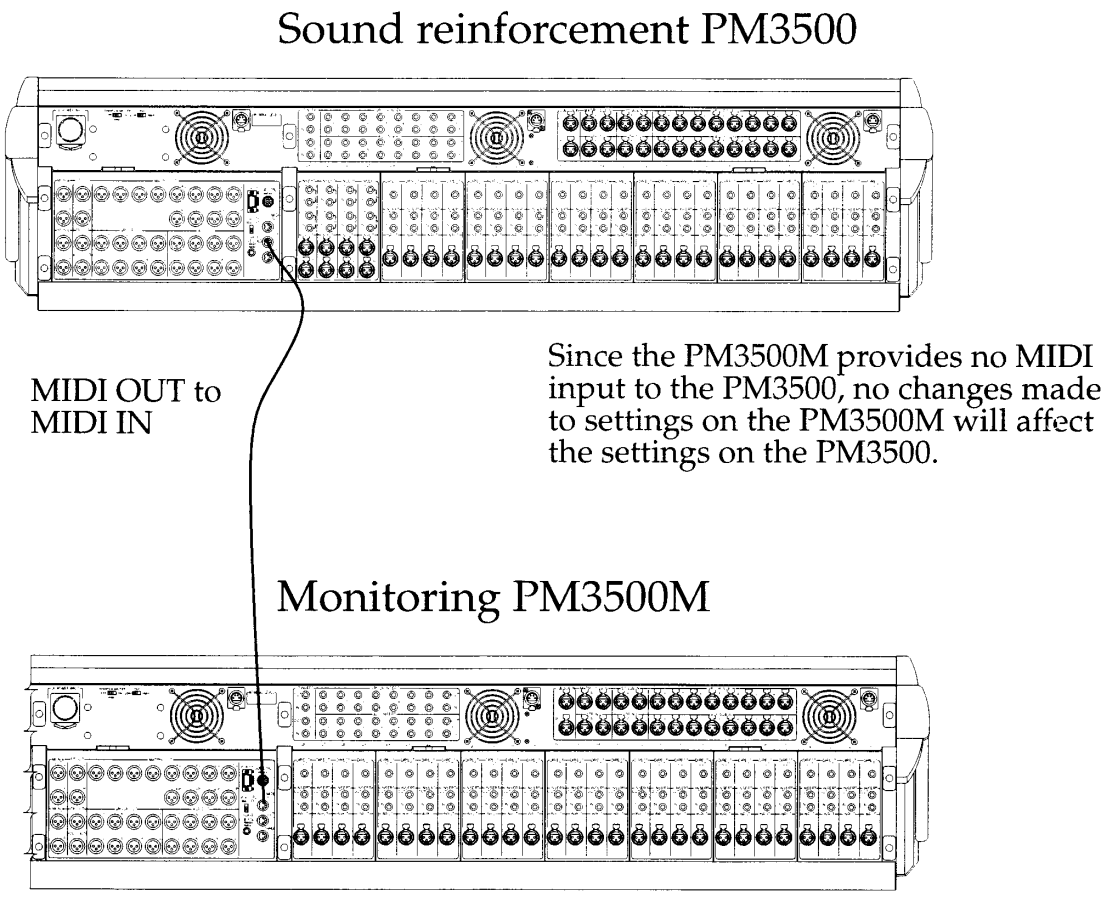
In this case, the extensive range of SUB INs can allow one PM3500M to act as a 52-channel submixer (!) feeding the "master" PM3500Mthrough the group, AUX and stereo SUB INs.

By connecting the VCA connectors and setting one console to Master and one to Slave (see [107] (page 34), the VCA levels of one console can be controlled from the other, giving an impressive degree of control (up to 104 channels!) from one console.

Of course, the PM3500M can be linked, not only to another PM3500M, but also to its sound-reinforcement brother, the PM3500. This is very useful when, for instance, the same snake/splitter is used to feed the inputs of the sound-reinforcement and monitor consoles on a one-to-one basis (i.e. on both consoles, channel 1 is the kick drum, channel 2 is the snare, etc.).

By designating one console (usually the sound-reinforcement) as a MIDI master, and the PM3500M as a MIDI slave, channel muting can be achieved on both consoles simultaneously. This can easily be overridden when necessary at the monitor console end when required (for example, suppose that the SR brass group mikes have been muted, but the sax player needs to tune his reed and needs to hear his sound (and nothing else!) from his monitor wedge).

The designation of MIDI master and slave is easily achieved by simply making the relevant connections in one direction, but not the other (see below):



9.9 Conclusion

The PM3500M is an extremely flexible piece of sound reinforcement equipment. This section has touched on a number of ways in which it can be used in different situations, but every situation is unique, and has different requirements. We are confident, though, that the flexibility of the PM3500M is such that it can be adapted to almost any situation, and we hope that the examples above will give you hints as to how to achieve your sound reinforcement needs most efficiently using the PM3500M.

10 Maintenance

10.1 Cleaning the console

10.1.1The console and power supply exterior

The console and power supply are painted with a durable finish. To avoid damage to the paint, control knobs, switch caps and other parts, **DO NOT USE SOLVENTS**. Instead, keep the console as free of dust as practical. Cover it when not in use, and brush or vacuum it periodically. The surface may be cleaned with a soft rag moistened with a dilute solution of non-abrasive detergent and water. If sticky gum is left on the panel (from masking tape or other tape used for channel labeling), it may be necessary to use a specialized solvent. In general, rubber cement solvent will remove tape residue without harming the console; however, it is your responsibility to test any such solvent in an inconspicuous location to ensure it does not attack the console finish or mar any plastic part.

Avoid getting the inside of the console wet from excessively wet rags. **DO NOT USE AEROSOL OR SPRAY CLEANERS.**

10.1.2Power supply air filters

The reticulated foam air filters on the front of the power supply screen cooling air as it is drawn through the unit. When the foam becomes clogged or dirty, it should be cleaned; check it periodically. Using a 3 mm Allen (hex) wrench, remove the four cap screws that secure each front grille. The foam elements may now be removed and rinsed in cool water. For greasy or stubborn dirt, dip the elements in a mild solution of detergent and water, then rinse with clear water. Blot and/or air dry the elements thoroughly before returning them to the amplifier. **DO NOT USE SOLVENTS TO CLEAN THE FOAM ELEMENTS.**

10.1.3Pots and faders

Yamaha **DOES NOT** recommend the routine use of any contact cleaners or solvents for cleaning pots or faders. Such "preventive maintenance" can actually do more harm than good by removing the lubricating film on certain pots or faders. While treatment with such solvents or cleaners may temporarily "clean up" a noisy control, it can also quickly result in a worn element (due to lack of lubrication) and even greater, incurable noise.

When a component is to be cleaned, use a very small amount of an appropriate cleaner, solvent, or pure isopropyl alcohol. Try to get it on the element, and immediately work the pot or fader several times all the way between stops.

In general, cleaning pots and faders is not a trivial task. Some have carbon elements, some have conductive plastic elements, and others have cermet elements. What cleans one part reliably may not work on another. When in doubt, consult your authorized Yamaha P3500 dealer or service center.

10.1.4The console interior

Dust and dirt are the enemy of electronic and mechanical systems. Switches and controls may wear prematurely due to the abrasive nature of dirt. A coating of dust may, in some cases, be conductive and change the electrical properties of the circuit. Similarly, dirt accumulations can reduce the thermal dissipation from heat sinks and transistors, leading to premature failure. It is advisable to use a soft brush or a vacuum cleaner with a soft brush attachment to clean the console periodically. Depending on the environment, this may be as often as once a month, or as infrequently as once a year. Use care not to bend or dislodge any components. Always do this work with the console power OFF.

If a beverage is spilled into the console, try to blot up as much excess moisture as possible immediately. If practical, immediately turn off the power and remove any affected modules. If not, wait until it is practical, and then turn off the power and proceed. Rinse contaminated parts on the module with distilled water, shake off the excess water, blot dry with a soft cloth, and air dry or use a warm (not hot) stream of air from a hair dryer to facilitate drying. If the console interior is contaminated, wipe it clean with a water-moistened cloth.

It is best to clean a spill as soon as possible. Unsweetened black coffee is probably the least harmful. The sugar in sweetened coffee can leave a sticky film on parts, and cream or milk will leave a residue that can be very troublesome. Similarly, sweetened soft drinks and fruit juices can leave sticky residues that degrade the performance of switches, faders and pots.

NOTE

For module removal and replacement see page 81.

10.1.5Meter lamp replacement

The VU meters and meter-assign indicators are illuminated by LEDs which should not require replacement.

Contact your Yamaha dealer or service facility should a meter illumination LED fail.

10.2 Where to check if there is no output

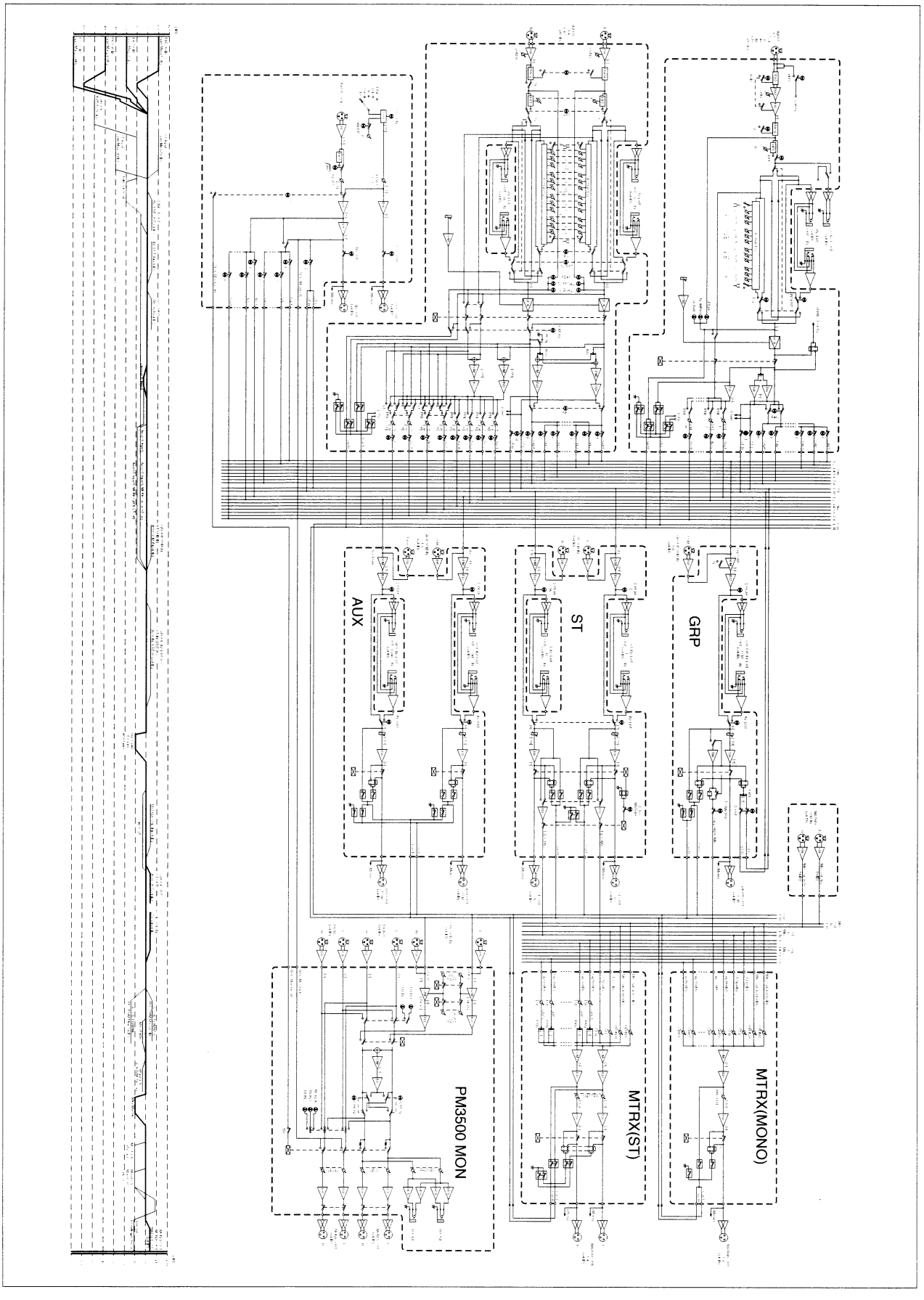
In general, when something appears not to be working properly in a sound system, it is necessary to have a clear understanding of the system block diagram. One should look for a "good" signal by patching around suspect equipment, modules or circuits. Suspected "bad" cables can be replaced or swapped to see if the problem follows the cable. These techniques should be known to most experienced sound system operators. In the case of the PM3500 console, however, there are a number of apparent fault conditions, which the operator may inadvertently create simply by setting controls in a particular configuration, whereby no signal reaches the output. The following chart depicts the most likely errors you may encounter, and points out how to correct the problem.

"FAULT" condition	Possible cause	Correction
Input channels do not appear at the group, stereo, aux or matrix outputs	Console is in SOLO mode, and an input channel to which no signal is applied has its CUE switch engaged.	Release master SOLO mode to activate all channels which should be on.
	The affected input channel does not have its ON switch on	Turn on the channel(s)
Certain input channels or groups of channels cannor be heard at group, stereo, post-fader aux sends or matrix outputs	The affected input channel(s) have VCA assign switches engaged, and the VCA fader(s) to which the channel(s) are assigned are set to minimum,	De-assign the channel(s) from the VCA group(s) or raise the appropriate VCA master fader(s).
	The affected input channel(s) have VCA assign switches engaged, and the remote VCA connection is causing the VCA master level to go to minimum	Disconnect the VCA connector. If the output is restored, check the remote device.
Certain input channels or groups of channels cannot be heard at group outputs, group-to-stereo outputs or group-to-matrix outputs.	The affected input channels are assigned to a group fader which is set to minimum level, and the group-to-stereo outputs or group-to-matrix feeds are set to post-fader	Raise the appropriate group master fader
An individual input channel cannot be heard group, aux or matrix outputs	Channel ON/off switch is off, or its PAD and GAIN controls are set so that the input sensitivity are too low.	Turn the channel on. Set the pad for a lower value and/ or the gain at a higher value.
	The channel insert switch is engaged, and a plug is connected at the channel's INSERT IN jack, but no signal is applied to that plug.	Disengage the channel's insert switch or chack the signal at the INSERT IN jack.
	A phantom-powered condenser microphone or direct box is connected to the channel and is not receiving phantom power.	Check that the channel's and master 48V switches are on.
There is no output, and no console functions work at all.	Power is not reaching the PM3500.	Make sure that the PW4000 power supply is on, and that the umbilical cables are properly connected. Check the fuses and the AC voltage.
Fuses are OK, and the power supply turns on, but the console does not turn on.	The umbilical cord is not connected correctly.	Reconnnect the umbilical cors.

10.3 What to do in case of trouble

The PM3500 is supported by Yamaha's worldwide network of factory trained and qualified dealer service personnel. In the event of a problem, contact your nearest Yamaha PM3500 dealer.

Level diagram



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01 05 30 CR Printed in Japan

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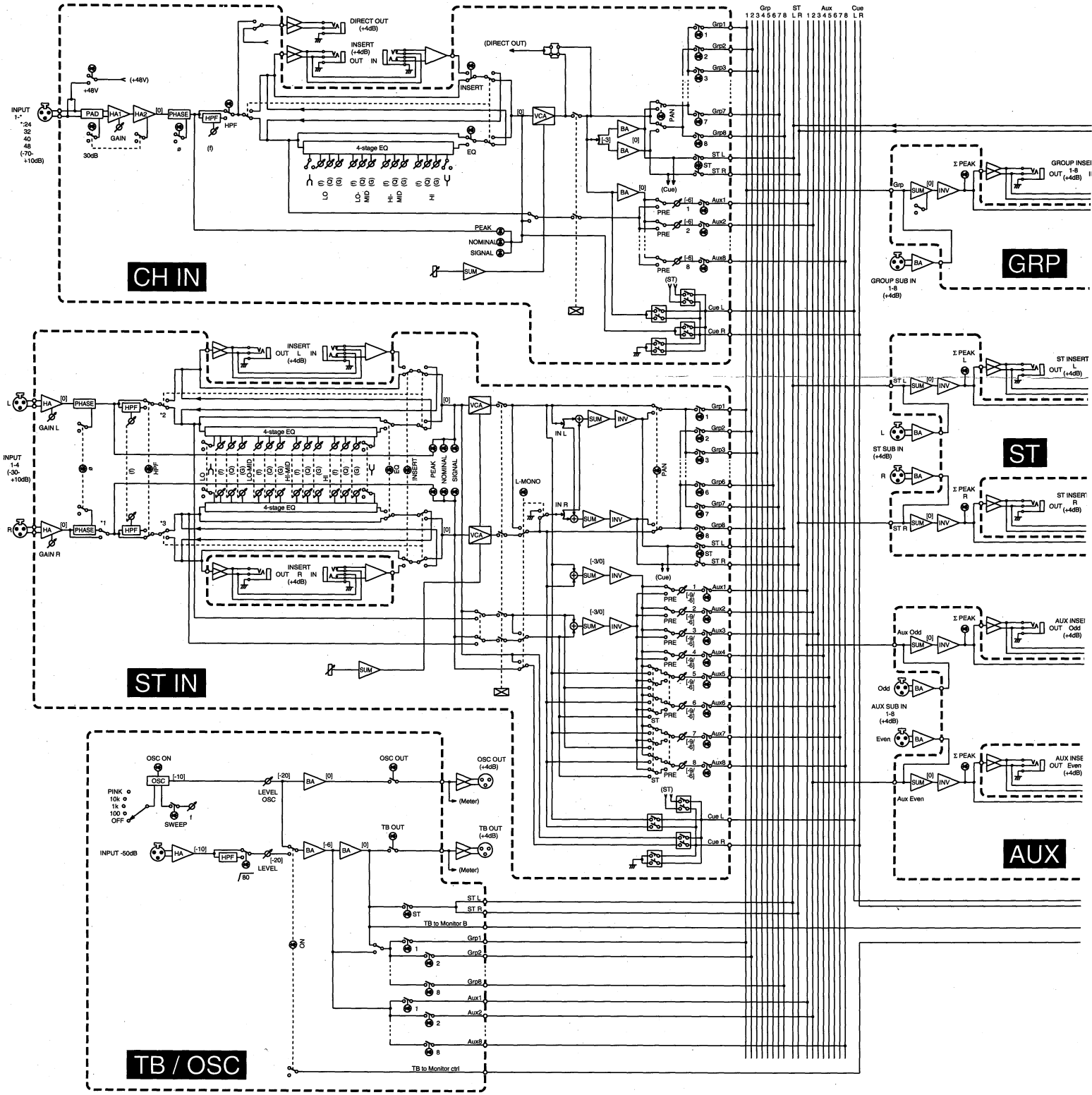
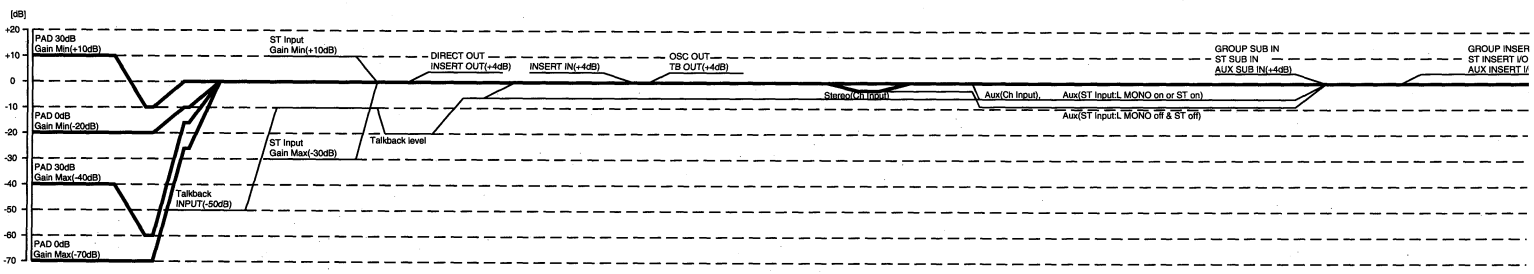
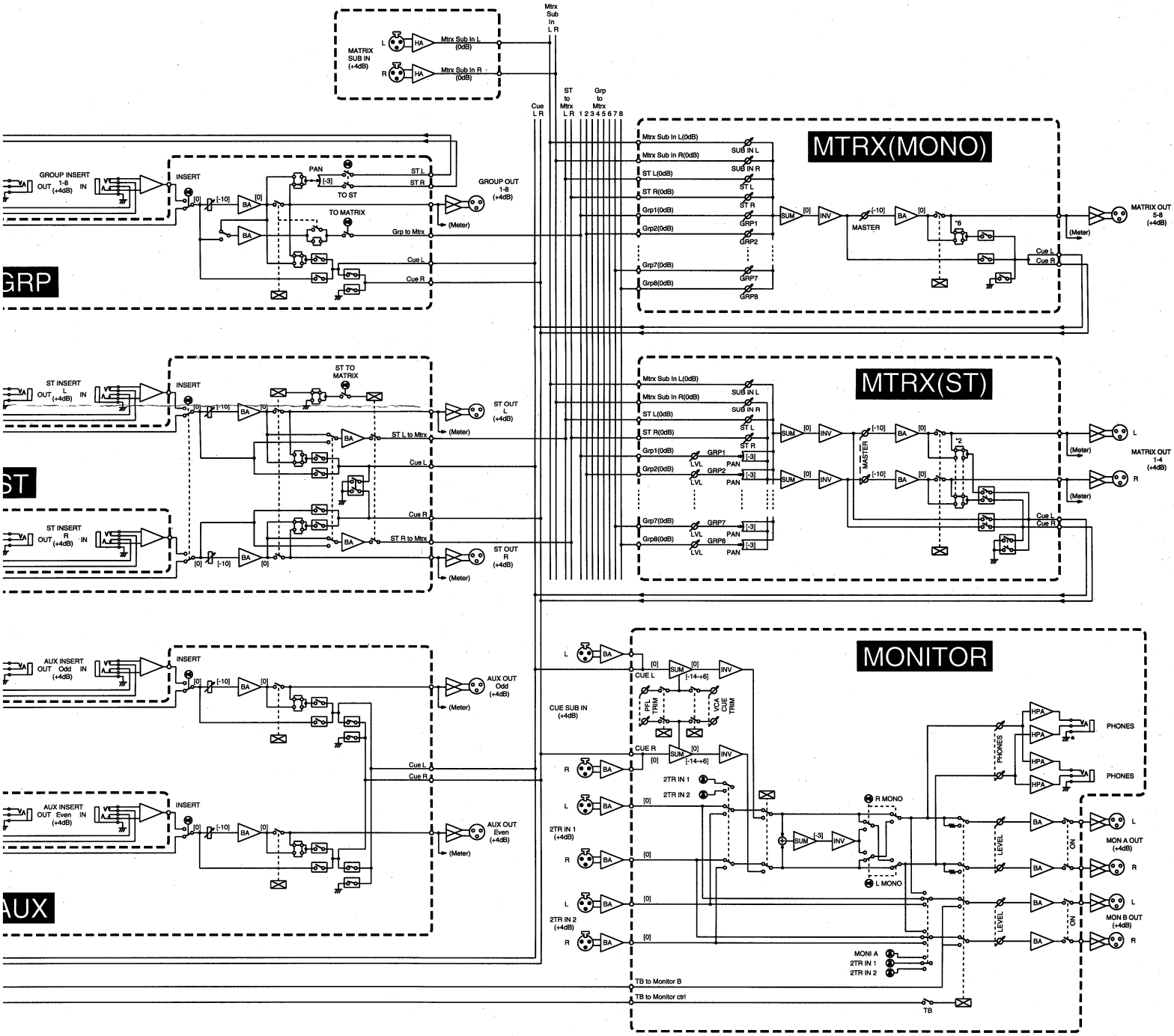
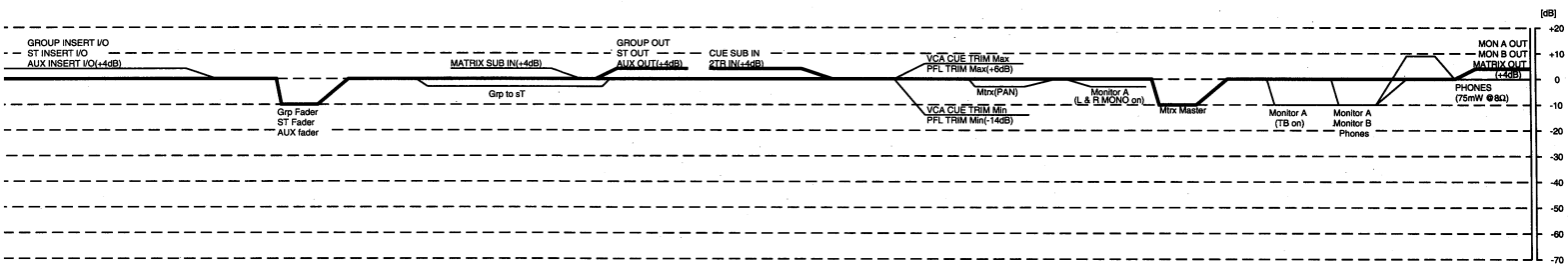
Block and level diagram






MATRIX SUB IN (+4dB)
Mtrx Sub In L (0dB)
Mtrx Sub In R (0dB)
Mtrx Sub In L R
Cue L R
ST to Mtrx L R
Grp to Mtrx 1 2 3 4 5 6 7 8
GRP
GROUP INSERT OUT 1-8 (+4dB) IN
INSERT
PAN
ST L
ST R
TO ST
TO MATRIX
Grp to Mtrx
Cue L
Cue R
GROUP OUT 1-8 (+4dB)
(Meter)
MTRX(MONO)
Mtrx Sub In L(0dB)
Mtrx Sub In R(0dB)
ST L(0dB)
ST R(0dB)
Grp1(0dB)
Grp2(0dB)
Grp7(0dB)
Grp8(0dB)
SUB IN L
SUB IN R
GRP1
GRP2
GRP7
GRP8
SUM
INV
MASTER
*6
MATRIX OUT 5-8 (+4dB)
ST
ST INSERT L OUT (+4dB) IN
ST INSERT R OUT (+4dB) IN
ST TO MATRIX
ST L to Mtrx
ST R to Mtrx
ST OUT L (+4dB)
ST OUT R (+4dB)
MTRX(ST)
LVL
PAN
*2
MATRIX OUT 1-4 (+4dB)
AUX
AUX INSERT OUT Odd (+4dB) IN
AUX INSERT OUT Even (+4dB) IN
AUX OUT Odd (+4dB)
AUX OUT Even (+4dB)
MONITOR
CUE L
CUE R
CUE SUB IN (+4dB)
PFL TRIM
VCA CUE TRIM
2TR IN 1
2TR IN 2
2TR IN 1 (+4dB)
2TR IN 2 (+4dB)
R MONO
L MONO
LEVEL
ON
MON A OUT (+4dB)
MON B OUT (+4dB)
PHONES
HPA
MONI A
TB to Monitor B
TB to Monitor ctrl
TB


[dB]
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
GROUP INSERT I/O
ST INSERT I/O
AUX INSERT I/O(+4dB)
MATRIX SUB IN(+4dB)
GROUP OUT
ST OUT
AUX OUT(+4dB)
CUE SUB IN
2TR IN(+4dB)
VCA CUE TRIM Max
PFL TRIM Max(+6dB)
Mtrx(PAN)
VCA CUE TRIM Min
PFL TRIM Min(-14dB)
Monitor A
(L & R MONO on)
Mtrx Master
Monitor A
(TB on)
Monitor A
Monitor B
Phones
MON A OUT
MON B OUT
MATRIX OUT
(+4dB)
PHONES
(75mW @8Ω)
Grp Fader
ST Fader
AUX fader
Grp to sT