

FASST

Field Associate Sound System Training

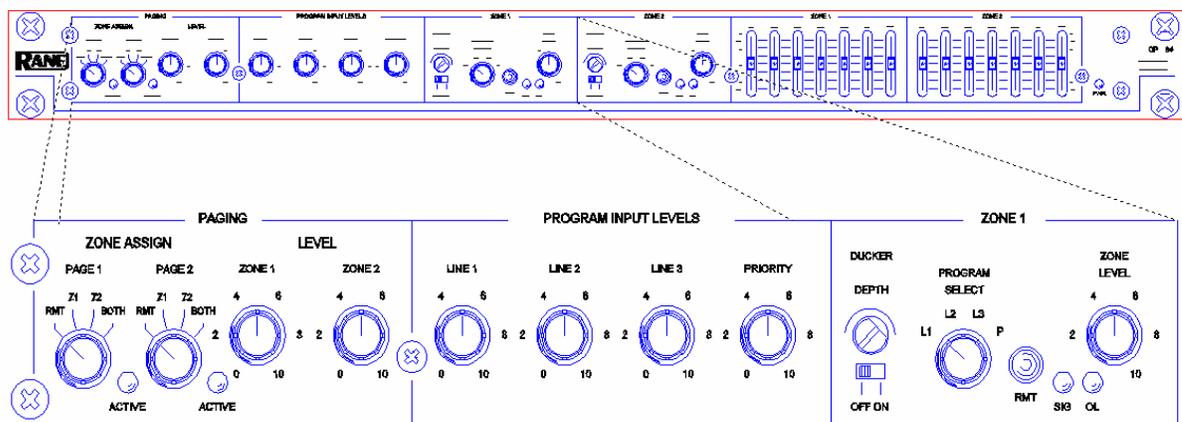
Mixers & Mixer Amplifiers

This module will briefly cover the mixer in general, but will focus mostly on the TOA modular 900 series and Rane's CP series as they are the most frequently used and most difficult to set up.

Generally, a mixer does exactly as its name implies. It mixes multiple audio signals into one. Those signals may be line level music and messaging, mic level paging, or even simple tones. It is very important to know the level of the signal that is going to be sent into a mixer because certain inputs have different levels of gain. More than one person has damaged their home system by plugging their CD player into the phonograph input. That is because there is an amplification stage to the input that is designed to amplify a small signal up to a line level. Start with a relatively large line level signal and it is just going to get even bigger.

Rane CP Series

The commercial processors from Rane are multifunction mixers. There are 3 in the series, but we will look at the features of the largest, and leave it to the reader to proactively research those features that are available on the smaller units. The nomenclature that Rane gives its products normally will lend a clue to what it does. The CP-31, CP-52, and CP-64 are commercial processors (CP) that have 3 inputs – 1 output, 5 inputs – 2 outputs, and 6 inputs – 4 outputs respectively. The inputs are not necessarily all the same, nor are the outputs.



In the figure above, we have a CP-64 with all the inputs and the controls for zone 1 enlarged. This unit has two paging inputs that can either be line level or mic level signals. This selection is made with a switch on the rear of the unit. In the paging section on the far left, the zone assign allows the user to specify the zones that the paging will be heard in and the level of the mic(s) in the respective zone.

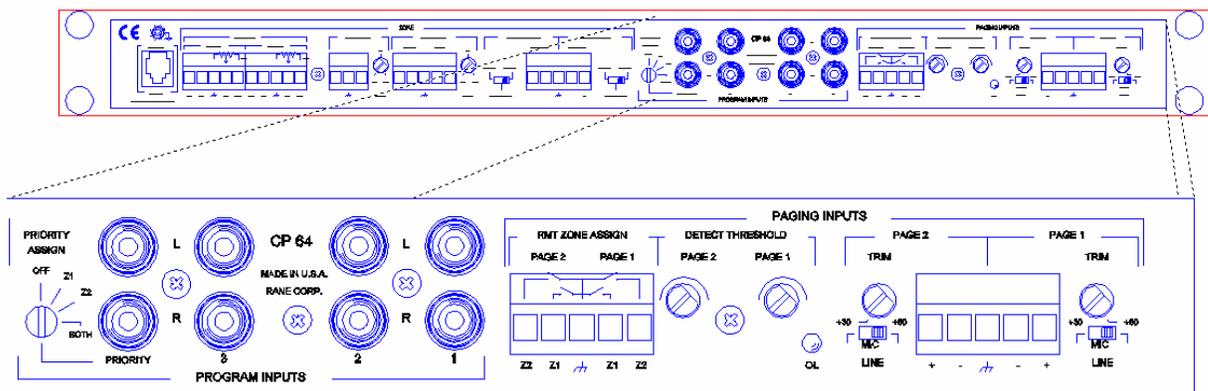
The center Program Input section allows for up to four line level inputs. This is where the different signal levels can be balanced out. Typically, the loudest or hottest source should have its level around 7 and the rest balanced accordingly. Notice that the fourth line input is labeled as priority. This is a common term when dealing with mixers. A priority input is one that will override all others. The priority designation for line input 4 can be turned on or off depending upon the users needs. (see reverse image below)

The remaining section on the front of the unit deals with the output control. There is a second identical box on the front labeled zone 2 that is not shown in the enlargement. The source select control is used to manually select one of the 4 line level inputs. The level control essentially is the volume control for that zone. The remaining control affects the ducking characteristic for that zone. Ducking is the muting of the music when the CP-64 senses an active page. This

feature can either be turned on or off with the switch. The level of the ducking is controlled using the potentiometer. A full duck will completely mute the music when the page is active while a partial duck will leave the music audible, but lower than normal. By activating the ducking feature, we are establishing yet another priority level amongst the 6 inputs. The order of importance becomes this: Paging, priority line level, and normal line source.

Rane also manufactures remote controls for this unit that connect to the back. These remotes can control source select, paging, and level control. In order for the remotes to operate, the RMT button on the front needs to be pushed in for the appropriate zone. This button simultaneously disables the respective source select and level controls.

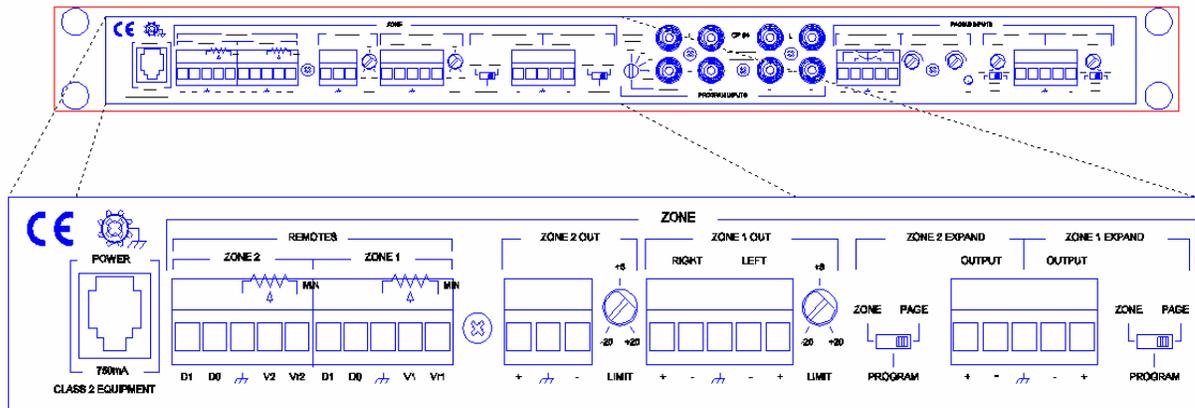
One other note for the front panel. Rane does make a small cover that mounts over the 7 band equalizers. This is done using the two small Phillips screws on each side of the EQ portion.



Looking at the input section of the rear panel, we can see the priority assign rotary switch that was previously mentioned. The fourth line level input can be assigned a priority status for one or both zones.

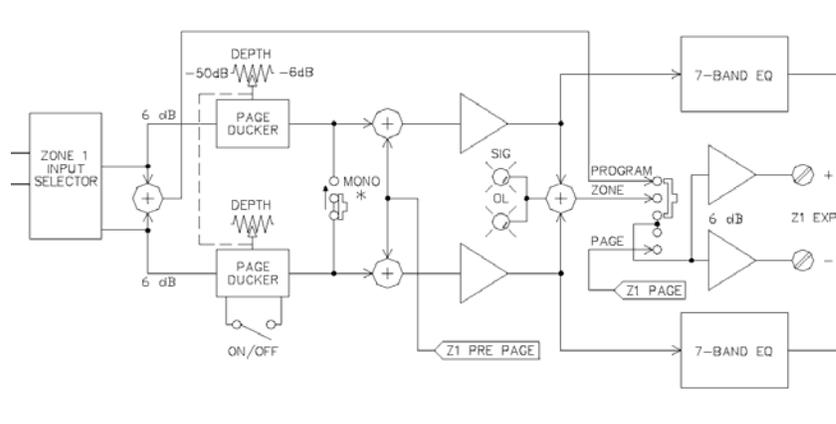
The *trim* pots in the paging input section allow us to balance the levels of the two paging devices. They are properly set when the overload light(OL) occasionally illuminates when speaking loudly into the microphone. The trim controls should be set with the paging level inputs on the front turned completely down.

The *detect threshold* pots must also be set for proper operation. These controls tell the system at what level the paging feature will engage. It is essentially an audio sensing relay that automatically turns the paging circuit on and off. Set too low and the processor could randomly mute the music based upon inducted or background noise. Set too high and the pages might not be heard from someone with a soft voice. The best way to set this level is by having someone with a rather soft voice speak into the mic. Turn the threshold up until the active light on the front panel comes on. If the gate is reacting to the background noise, you'll need to adjust the threshold up and instruct the speaker to get closer to the mic and speak as loud as possible.



On the left side of the CP-64 is where the 4 outputs are located. Recall from the front panel the level control in Zone 1 and an identical control for Zone 2. These two controls effect the Zone 1 stereo out and Zone 2 mono out respectively. Each of these outputs has a limit control that sets the threshold for the function to activate. The limiting function is virtually inactive when set at +20dBu. The level should be set so that the limiting function becomes active at the loudest point the sound system should ever be. In reality, it is hard to simulate those levels unless the setup is done during one of these periods. Keep in mind that a loud level in an empty space can be nearly inaudible when people and noise are added into the equation. Refer to the signal processing section for more information on limiters.

Remember there are 4 outputs to the CP-64. The other two outputs are what Rane has termed 'expand'. These outputs, located on the right side of the enlargement above, are fixed level outputs. They can be assigned to be page only, program only, or replicate the entire signal in that particular zone. Note that the circuit in the zone mode doubles the output voltage as seen in the schematic below.



Other interesting CP-64 factoids:

- Unit can be switched to a mono unit via an internal switch
- All front panel knobs can be pulled off and replaced with a plug type cover.
- Program Priority has variable threshold and release settings via internal potentiometers
- As a default, the page 1 input has priority over page 2. The priority can be either reversed or turned off so that the two pages mix together. This is done with an internal switch.
- Each zone can be configured such that the paging is independent of the zone level control. Default has the level control adjusting both the page and source levels simultaneously. This selection is made via an internal switch for each respective zone.

TOA 900 Series

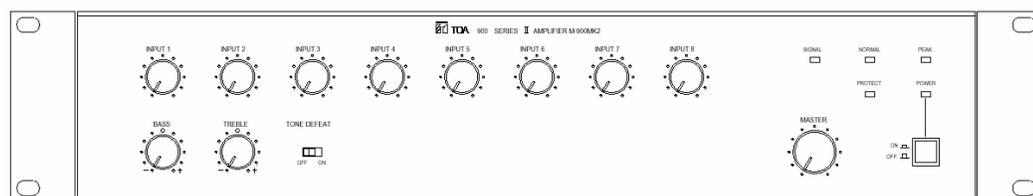
The 900 Series is a modular design that allows the user to configure inputs as needed. The 900 Series can be split into 3 distinct groups: the mixer, mixer/amplifiers, and power amplifiers. The nomenclature TOA uses very clearly indicates what the device is and how large its amplification stage is (if it has one). There is also a suffix on the model #'s. An MKII represents the newest version and has a black finish. The MKII design was first introduced in the early 90's. The older A version has a gray finish.

Prefix	Function
M	Mixer
A	mixer/Amplifier
P	Power amplifier

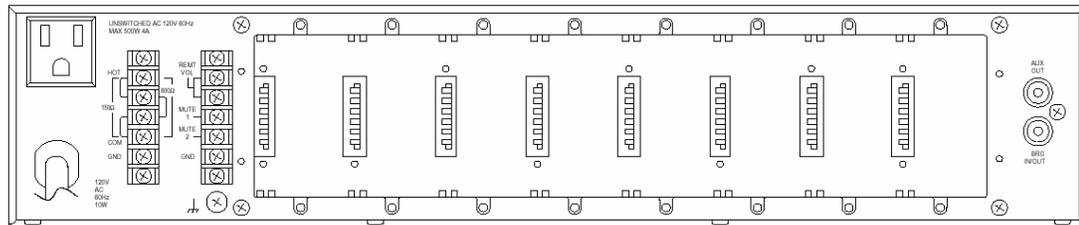
Model #	Amplification
900	Mixer Only
903	30 watts
906	60 watts
912	120 watts
924	240 watts

Therefore, an M-900MKII is a mixer, an A-906MKII is a 60 watt mixer amplifier, and a P-912MKII is a 120 watt power amp.

TOA M-900MKII mixer



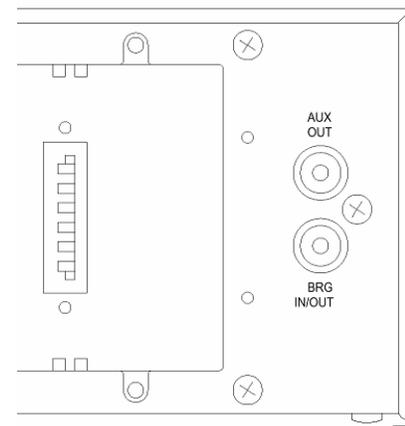
The M-900MKII is an 8 channel mixer. Each channel has it's own independent level control to balance the signals. There is also a master level control that is used to adjust overall levels. The Bass and Treble controls can be disabled by turning the tone defeat switch on. This switch is located immediately to the right of the treble control.



TOA M-900MKII

Visible from the rear of the mixer are 8 slots where the modules can be inserted. To the right of that are 2 RCA connectors labeled AUX OUT and BRG IN/OUT.

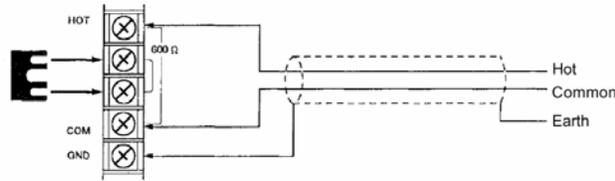
The Aux outputs on all 900 series equipment are a high impedance (10k ohm) output. It was designed to be used in conjunction with a U series module that has a 220k ohm input impedance. Connecting this output into an auxiliary input on any other piece of audio gear will likely result in a significant level drop because most inputs are 10k Ohm.



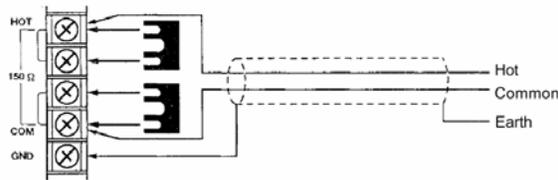
The bridge (BRG) connector is designed to connect with the bridge connector on another TOA mixer or mixer amp. In this configuration, we want to match impedances so that the voltage is shared evenly across both devices. We wouldn't want one mixer having most of the signal and the other having none. This connector can also be used as a fixed level output to another piece of gear since the level is independent of the master level control. Since the impedance is 3.3k ohms, it should be connected to a device that has an input impedance greater than 33k ohms, satisfying the 10 to 1 rule.

On the left hand side of the M-900 are two separate terminal strips. The left-most is the output terminal where a 150 ohm or 600 ohm connection can be made to the amplifier. Typically, the 150 ohm connection will be used. Understand that this connection requires two jumpers as shown in the diagram below.

【600-ohm connection】

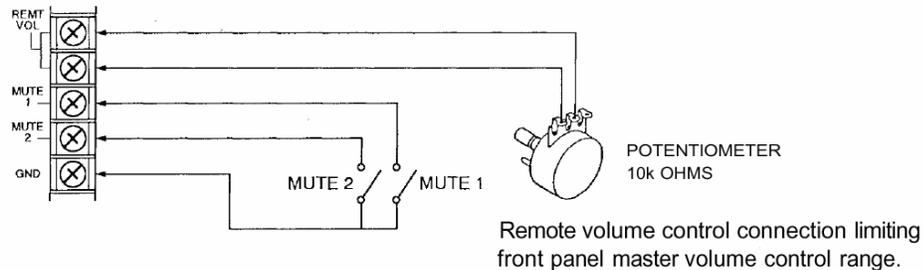


【150-ohm connection】



TOA M-900MKII output terminations

The other terminal strip is for connection of a 10k ohm linear taper potentiometer to facilitate remote control and termination of switches to engage the mute bus.

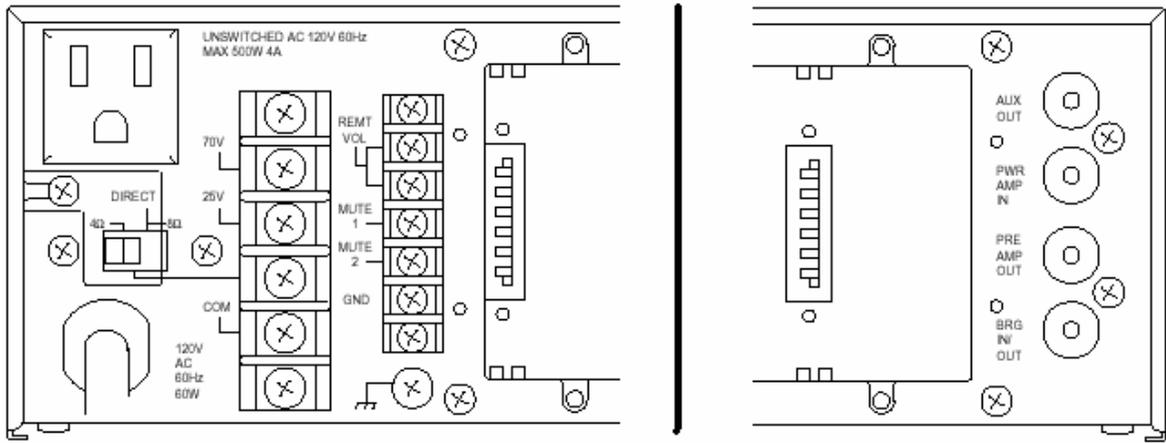


Remote and Mute Terminations

900 Series Mixer/Amplifiers [A-903MKII, A-906MKII, and A-912MKII]

All 3 of these units are very similar to the M-900 except they have an amplifier built in.

On the front, the only difference is the addition of a low cut switch. When engaged, this switch rolls off frequencies below 60Hz. This can sometimes help with problems that occur with low frequencies including saturated transformers, distortion, and 60 Hz hum. Plus, many loudspeakers are not capable of reproducing those low frequencies anyway and the energy is wasted, often merely dissipated as heat.

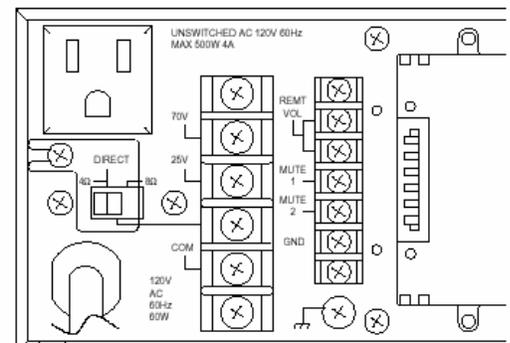


A-903MKII

On the rear of the unit the remote and mute terminals are identical. However instead of having a 150 or 600 ohm line level output, we now have both high and low impedance amplified outputs. Of particular interest is the low impedance screw terminal. Note the switch for that terminal between 4 and 8 ohms. The direct/8 ohm side of this switch passes the signal directly from the amplifier to the speaker terminal. When the switch is in the 4 ohm position, it is still passing through a transformer. Most commercial terminations will be done on the 70 volt and com terminals.

On the other side of the unit are two additional RCA jacks in addition to the AUX and BRG connections discussed earlier. The Preamp out and power amp in terminals allow additional processing of the signal prior to the amplification stage. An example might have the mixed audio signal coming out of the pre amp out to an equalizer and then back in the power amp in. Keep in mind when an RCA plug is connected to the pre amp out connector, the signal path to the amplifier is broken. No audio will be heard until the signal is routed back into the power amp in connector.

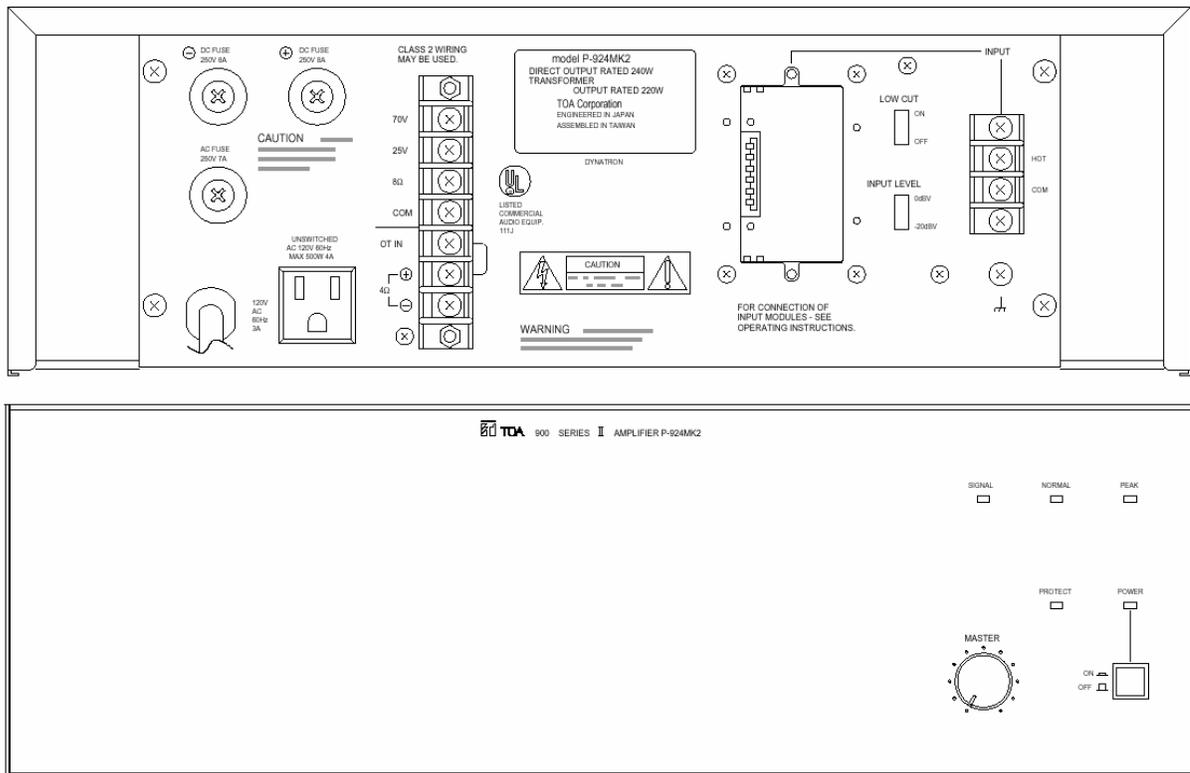
Other than the power levels, there is one significant difference between the 903, 906, and 912. As previously mentioned, the low impedance output of the 903 is directly off the amplifier in the 8 ohm mode. As shown in the diagram, the direct mode on the 906 and 912 is in the 4 ohm mode.



A-906MKII / A-912MKII

The important thing is to make sure that the switch is in the proper impedance position if using the amplifier to drive a 4 or 8 ohm load.

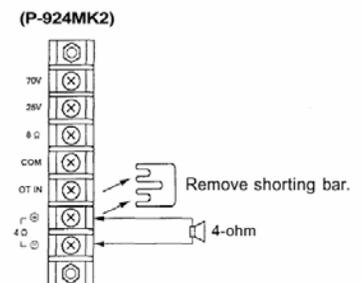
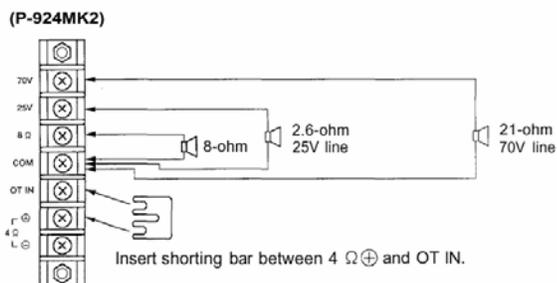
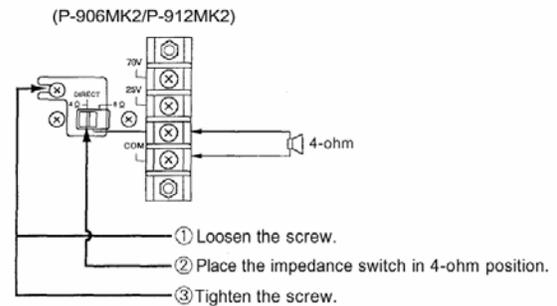
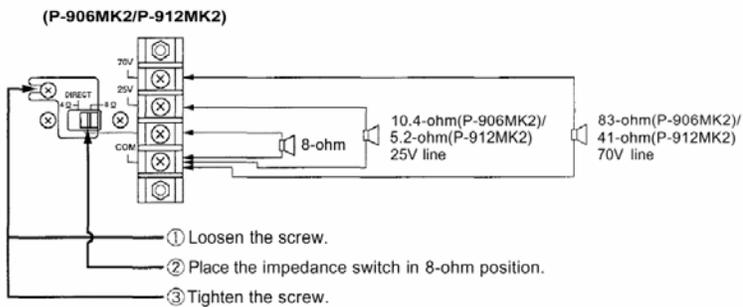
900 Series Power Amplifiers [P-906MKII, P-912MKII, and P-924MKII]



TOA P-924MKII

The P series amplifiers are single channel amps. As seen in the figure above, there is only a master level control on front. These units do not have any tone control. There is however, a low cut switch located on the back.

On the back of the unit, the amplified terminations are similar to the A series mixer amps. (See diagram below for sample terminations.) They have a hard wired input for unbalance line level signals with an input level selection switch to give added gain if the input signal is low. Normal application would have this switch in the 0dBV position. One 900 series module may be used with these amps for signal input, but a module may not be used in conjunction with the hard wired input terminals.



All 900 series mixers and amplifiers, except for the 924, are 2RU devices that use the MB-25B mounting bracket for rack installation. The 924 is a 3RU device that requires an MB-35B.

900 Series Modules

The modules are what make the 900 series so flexible (and at times confusing). TOA is continually designing and producing new modules that give added flexibility to these mixers. Similar to the nomenclature of the chassis', the modules are intuitively named so the installer has an idea of their function. Never the less, it is highly recommended that anyone installing or servicing TOA equipment have the 900 series module guide at their disposal. It is an excellent resource and far superior to the little piece of crap documentation that they include in the module box. This guide is electronically available from TOA's web site at www.toaelectronics.com/mod0004.asp.

The following charts categorize the different modules, their functions, and connectors.



900 MK2 Series Input Module Selection Chart



Female XLR



Male XLR



1/4" Phone
Jack



RCA Jack



Dual RCA
Jacks



3 Screw
Terminals



5 Screw
Terminals



Removable
Terminal Block

		Female XLR	Male XLR	1/4" Phone Jack	RCA Jack	Dual RCA Jacks	3 Screw Terminals	5 Screw Terminals	Removable Terminal Block
Microphone Input Modules	Standard with high/low cut filters	M-01F	M-01M	M-01P			M-01S		
	Mute - Receive with high/low cut filters						M-11S		
	Mute - Send with high/low cut filters								M-41S
	Voice gate with low cut filters	M-51F					M-51S		
	Compressor with high/low cut filters	M-61F					M-61S		
	Remote volume control with high/low cut filters							M-21S	
	For high-Z microphone only with high/low cut filters			M-03P					
Line Input Modules*	Standard	L-01F B-01F U-01F		U-01P	U-01R		L-01S B-01S U-01S		
	Standard with high/low cut filters					U-03R			U-03S
	Mute - Receive				U-11R		L-11S B-11S U-11S		
	Mute - Receive with high/low cut filters					U-13R			U-13S
	Mute - Receive with variable mute depth						U-12S		
	Mute - Send						L-41S		B-41S
	Mute - Send with high/low cut filters					U-43R			U-43S
	Remote Volume Control							B-21S U-21S	
	Compressor						U-61S		
	Line output						T-01S		
Special Function Modules	Line input with Music on Hold output							T-02S	
	Line input with MOH output & input Mute - Receive							T-12S	
	1 KHz sine wave test tone						S-01S		
	Buzzer/Yelp signal tone						S-02S		
	Switch selectable tone						S-04S		
	Equalizer for F-121C/CM Speakers					E-03R			
	Equalizer for H-1 Speakers					E-04R			
	Equalizer for H-2/H-2WP Speakers					E-05R			

Note how the prefix matches up with the corresponding input, the number corresponds with the function, and the suffix corresponds with the connector type.

Prefix	Input Type
U	Unbalanced Line Level
B	Balanced Line Level
L	Line (impedance) matching
M	Microphone

Prefix	Input Type
S	Signal Generating
T	Special function
E	Equalizer

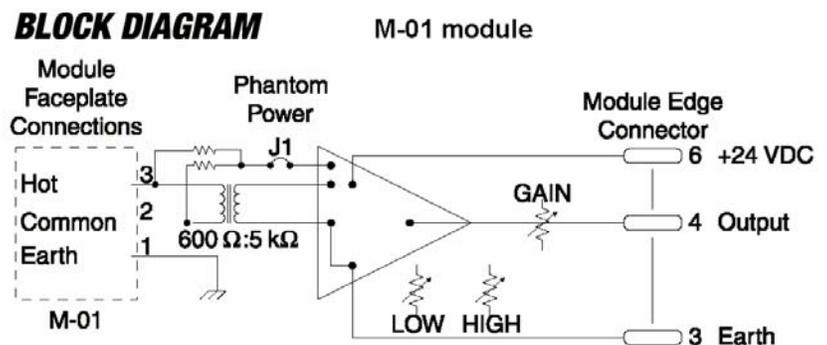
Microphone Modules

Let's first look at the microphone modules. Most people hear the word TOA and microphone in the same sentence and automatically think 'wire it backwards'. TOA has taken quite a bit of

abuse (not unwarranted I think) because their wiring configuration is at odds with the rest of the industry. TOA likes pin 3 hot instead of pin 2 like most (but not all) other manufacturers. Pioneer DJ mixers have been found with pin 3 hot too! TOA is working around this with the new terminal block connector by labeling the pins with H (hot), C (common), and E (earth).

With the exception of the M-03P, which is a beast of a different color, all microphone modules come with phantom power engaged. That means the module is sending +22 volts DC out to the microphone. This polarizing voltage is required for condenser-type microphones to operate. In our applications, we

predominately use dynamic microphones that do not require this voltage. Therefore jumper J1 should almost always be cut. Not cutting this jumper for condenser mics can create popping in the system when the microphone switch is engaged or possibly lead to premature microphone failure. Why send voltage where it is not needed?



I normally think that this should go unsaid, but last month I was at a site that had their line level signal connected to a microphone input module. Needless to say, with the 30-50dB of gain that these modules are providing, the installer had to turn the signal way down to keep the amp from clipping. I'm not sure you can imagine the noise level they were putting through the speakers and the customer couldn't understand why it sounded so bad! Moral of the story: Microphone modules are for microphones.

Also, avoid wiring microphone modules in parallel. Remember that most microphones will give us 50 mV on a good day at 150 Ohms impedance. Screwing up our impedance on such a low signal could be deadly.

Line Level Modules

Next we'll take a look at the line level input modules. Without going into the differences between balanced and unbalanced signals, suffice it to know that there are different modules for each type. Basically, unbalanced (U) modules should only be used when the source is located very near (<6 feet) the mixer/amplifier. If the source is further away and does not provide a balanced output, the signal should be balanced using an appropriate transformer and sent into a balanced (B) module. These balanced modules provide some degree of transformer isolation and can be used for both balanced and unbalanced signals to help eliminate ground loops.

All B modules have an input impedance of 10k Ohms. Why do you care? Let's set up a hypothetical system with the preceding device having an output impedance of 150 Ohms. Using our parallel equations provided during the FASST Sound System Basics module, we see that we can tie up to six modules in parallel and still effectively transfer most of the voltage to the B modules by maintaining our 10 to 1 rule. If however, our preceding device has a 600 Ohm output impedance, we could now only connect one device. Connecting the second module would lower the input impedance to 5k Ohms and would reduce our signal level.

Contrast the input impedance of the B modules with that of the U modules at 220k Ohms. Very high impedance indeed! Going back to our previous example with an output impedance of 150 Ohms, we could safely parallel 14 U modules together (not that I would recommend that! Remember, distribution amps are good things.)

The remaining line input module is the L series. These Line matching inputs all have a 600 Ohm input impedance, much like many phone systems. The name line matching transformer is a bit misleading in that it assumes that the sending device has the same 600 Ohm input. If the sending device actually had a 150 Ohm output impedance, it would hardly be line matching, would it? An interesting feature of the L modules is that you can cut the R1 jumper and convert the impedance from 600 to 10k Ohms. L-41S modules have been used frequently in the past for phone page input. However, TOA recently introduced the B-41S module which is a better solution for that application.

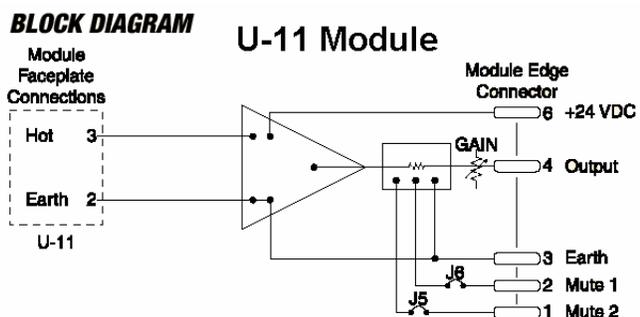
The last category is the 'I don't know where else to put it' Special function category. In this group, we have the line output (T) modules, signal generating (S) modules, and the 'my speakers suck so I am going to fix them with this' EQ (E) module.

The T modules can be handy for Music on Hold or for sending a balanced music signal a long way, possibly to a remote rack. The input and output versions do have separate gain controls to adjust both the input and output levels.

The S modules basically do as advertised. Upon seeing a dry contact closure, they will do their thing. Be aware of the wiring configuration though. The S-01S senses between pins 1 and 2. The S-02S generates two different signals depending upon if the closure is sensed between pins 1 and 2 (the buzzer) or 1 and 3 (the yelp). The S-04S has dip switch selectable tones that can either be a single tone (pins 1 and 3) or a continuous tone (pins 1 and 2).

There are 3 different E modules that correspond to specific TOA speakers. Bose has a similar product designed for some of their speakers. This module pulls the signal from the Pre-amp connector on the mixer/amp, manipulates the signal, and sends it back into the power amp in connector. The only reason it plugs into the chassis is to get its +24VDC of power!

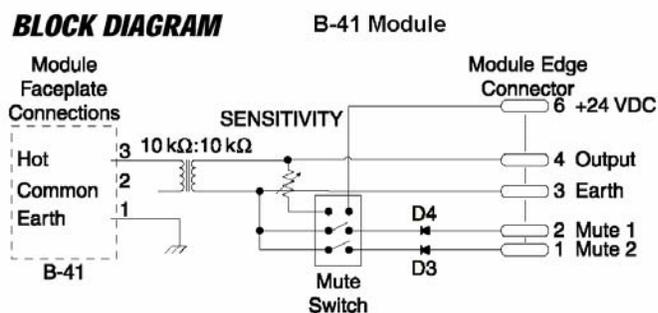
Muting



Now that we have covered each of the input modules, let's talk about muting. Modules either react to a mute (Mute-Receive), create a mute (Mute-Send), or ignore mutes altogether. These mute buses allow us to create priorities between sources much like the Rane equipment mentioned earlier.

Modules of type 11 and 13 react to a mute by completely muting the signal that is going into it. With two mute buses in the mixer, the module can either react to mute 1, mute 2, both, or neither. This configuration is established by cutting specified jumpers on the module.

It can be seen in the block diagram to the right that there is a jumper for each mute. By cutting the jumper, the module will no longer react to that particular mute bus. If both jumpers are cut, the module acts as a standard input module that does not mute at all.



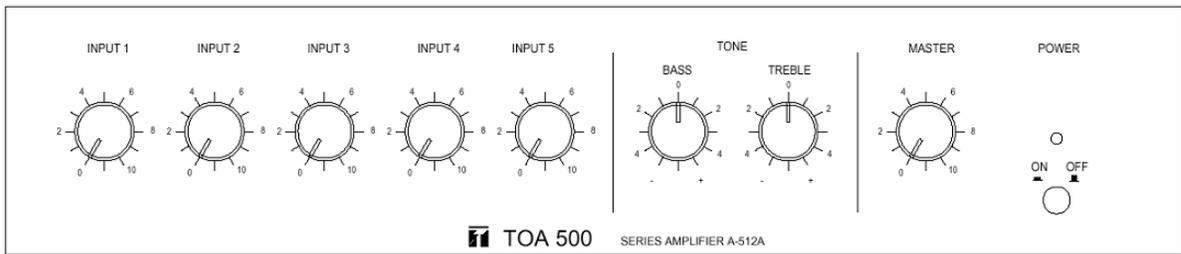
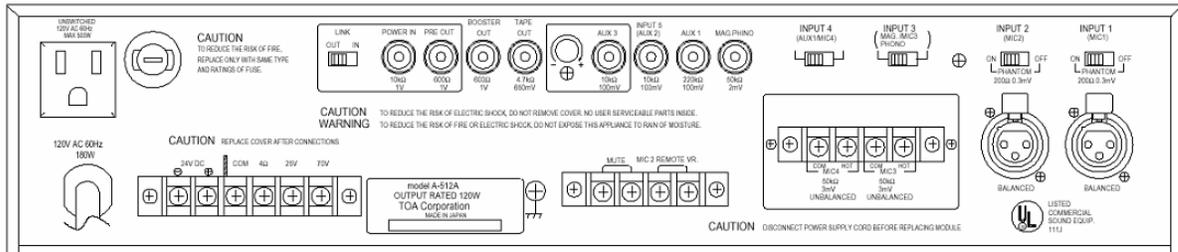
Modules of type 12 react in a similar manner to type 11's, but the muting or ducking level is variable. This level is adjusted with a potentiometer on the face plate of the module.

The mutes that type 11 and 12 modules react to can be generated either via a contact closure that shorts the mute terminal to ground, or an audio sensing module that can create the mute. These modules are known as mute send devices and are designated by the numbers 41 or 43. It is important to set the sensitivity levels on these modules so that they react at the proper times. The sensitivity potentiometer for the M-41 is located on the board itself, so that the card must be removed to make adjustments. Not exactly convenient, but that's the way it is. By contrast, the B-41 has the adjustment located on the face plate.

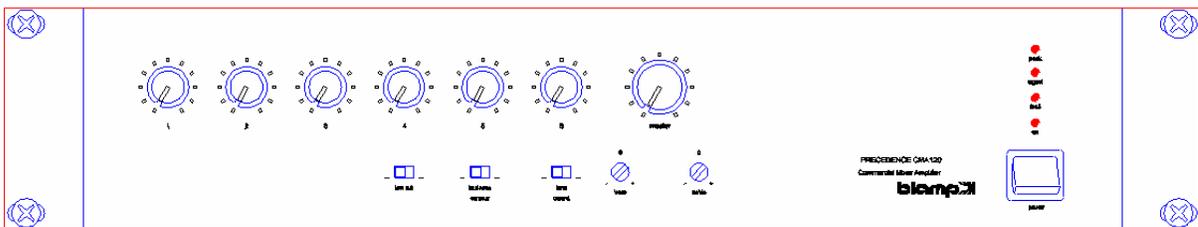
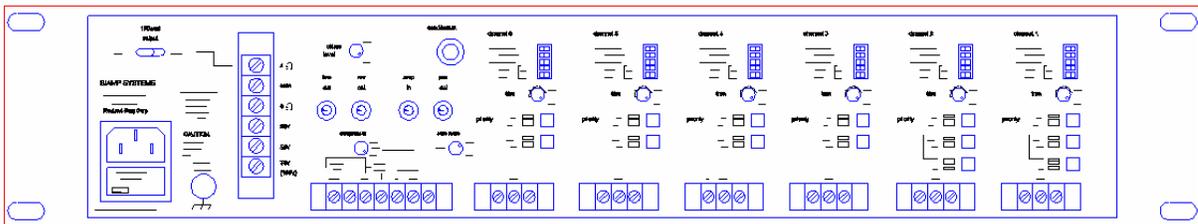
We recently installed a restaurant that used the M-41 modules for their kitchen microphones so that the cook didn't have to push the switch. They had music playing throughout the kitchen, but when someone spoke into the mic it would mute. The problem arose when the music muted, but never came back on. A return trip was required to make the sensitivity adjustment on the module.

TOA 500 Series and Biamp CMA Series

These mixer/amplifiers are very similar in that they are both a non-modular design. Their features and setup are very similar to the 900 series above.



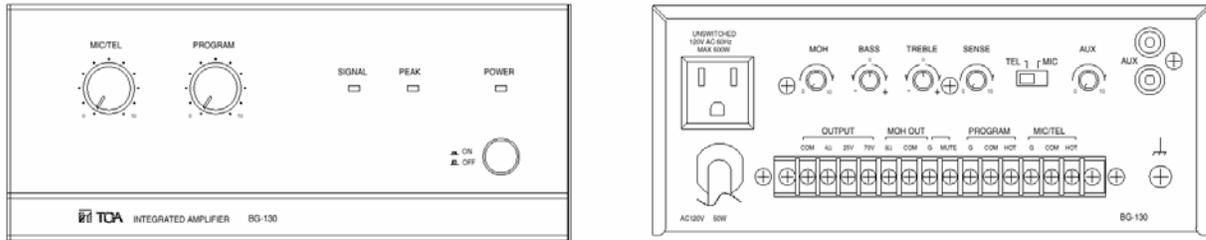
TOA A-512A



Biamp CMA 120

TOA BG Series

TOA also has a couple mixer/amplifiers that are geared towards smaller systems. The BG-115 and BG-130 mixer amps are 15 and 30 watt (@70.7 volts) models with limited mixing functions. The amp section is capable of power both high and low impedance 4 ohm loudspeakers.



Front & Back of BG 130

The mixing section is limited to the hardwired *program* input terminals, a microphone or telephone paging input, and the stereo Aux input RCA connectors. Program, Aux, and Tel inputs are all 10k ohm impedance, while the mic input is 600 ohm.

The unit employs an auto mute function that completely mutes the music. There is a sensitivity pot on the back of the unit to make this adjustment. Additionally, there are mute terminals for hard wire of a contact closure to initiate this function. It is possible using these terminals to mute both the PGM/AUX inputs and/or MIC/TEL inputs via an internal jumper. This could be useful for fire code applications that require all music and page functions to mute.

The program control on the front of the amp does not affect the aux level. The aux level is independently controlled by the pot in the back.

One nice feature of the BG series is the MOH output. This is a 1watt @ 8 ohm amplifier that does not mute or pass the paging signal. Internal jumpers allow the PGM and/or AUX inputs to be disconnected from the MOH output. The output level is controlled by a potentiometer on the back.

Rack mounts can be ordered separately. Two devices can be installed adjacent to each other in a standard 19" wide rack.