

MESA/BOOGIE

F-Series

F-30 ♦ F-50 ♦ F-100

Owner's Manual

Hello from the Tone Farm...

YOU, the smart player and all around intuitive human, have put your trust in us to be your amplifier company. This is something we do not take lightly. Our reward is that we've made a classic amplifier and by choosing this amplifier, you have become part of the MESA family...Welcome! Our goal is to never let you down. Your reward is that you are now the owner of an archetypal guitar amp bred of fine all tube amp heritage...benefiting from the many patented pioneering MESA/Boogie circuits that led to the refinement of your new instrument. Feel confident, as we do, that this amp will inspire many hours of musical satisfaction and lasting enjoyment. It was built with you in mind, by players who know the value of a fine musical instrument and the commitment it takes to make great music. The same commitment to quality, value and support we make to you...our new friend.

F-Series

F-30 • F-50 • F-100

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PRECAUTIONS & WARNINGS

Your MESA/Boogie Amplifier is a professional instrument. Please treat it with respect and operate it properly.

USE COMMON SENSE AND ALWAYS OBSERVE THESE PRECAUTIONS:

WARNING: EU: permission from the Supply Authority is needed before connection.

WARNING: Vacuum tube amplifiers generate heat. To insure proper ventilation always make certain there is at least four inches (100mm) of space behind the rear of the amplifier cabinet. Keep away from curtains or any flammable objects.

WARNING: Do not block any ventilation openings on the rear or top of the amplifier. Do not impede ventilation by placing objects on top of the amplifier which extend past the rear edge of its cabinet.

WARNING: Do not expose the amplifier to rain, moisture, dripping or splashing water. Do not place objects filled with liquids on or nearby the amplifier.

WARNING: Always make certain proper load is connected before operating the amplifier. Failure to do so could pose a shock hazard and may result in damage to the amplifier.

Do not expose amplifier to direct sunlight or extremely high temperatures.

Always insure that amplifier is properly grounded. Always unplug AC power cord before changing fuse or any tubes. When replacing fuse, use only same type and rating.

Avoid direct contact with heated tubes. Keep amplifier away from children.

Be sure to connect to an AC power supply that meets the power supply specifications listed on the rear of the unit. Remove the power plug from the AC mains socket if the unit is to be stored for an extended period of time. If there is any danger of lightning occurring nearby, remove the power plug from the wall socket in advance.

To avoid damaging your speakers and other playback equipment, turn off the power of all related equipment before making the connections.

Do not use excessive force in handling control buttons, switches and controls. Do not use solvents such as benzene or paint thinner to clean the unit. Wipe off the exterior with soft cloth.

Be sure to have the warranty card filled out by the store at which it was purchased and return to *Mesa/Boogie*.

YOUR AMPLIFIER IS LOUD! EXPOSURE TO HIGH SOUND VOLUMES MAY CAUSE PERMANENT HEARING DAMAGE !

No user serviceable parts inside. Refer service to qualified personnel. Always unplug AC power before removing chassis.

EXPORT MODELS: Always insure that unit is wired for proper voltage. Make certain grounding conforms with local standards.

READ AND FOLLOW INSTRUCTIONS OF PROPER USAGE.

F-Series

F-30 • F-50 • F-100

Operating Instructions

OVERVIEW:

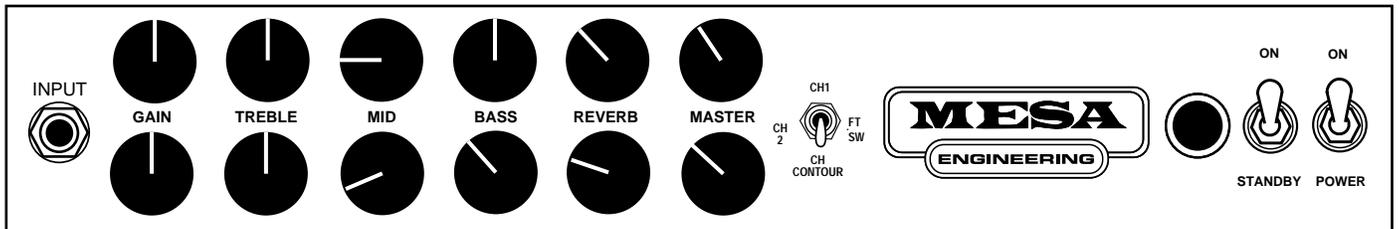
Congratulations on choosing the **F Series** as your amplifier and welcome to the **Mesa/Boogie** family! The new **F Series** amplifiers combines high gain lead performance, an amazing mid-gain crunch or blues sound and a bold and beautiful clean sound in a simple 2 Channel, Three Mode, all-tube, hand-built package that begs to rock. This tidy format is available in three power versions, the **F-30**, **F-50** and **F-100**, and in both head and self-contained combo platforms.

The bright and bouncy **F-30** with its 2xEL84 power string operating in our patented **Dyna-Watt** circuit is housed in the original **Boogie** 1x12 size and powers the legendary Celestion Vintage 30. This is perfect as a super portable, lightweight and surprisingly powerful combo. As a short head powering a 2x12 or 4x12, this little wolf in sheep's clothing shows its fangs and becomes a viable gig rig for mid size venues where its power clip can add a unique and dynamic personality. Like its forefathers, this little dynamo stays true to the little giant-killer tradition that won the first **Boogies** worldwide acclaim 30 years ago.

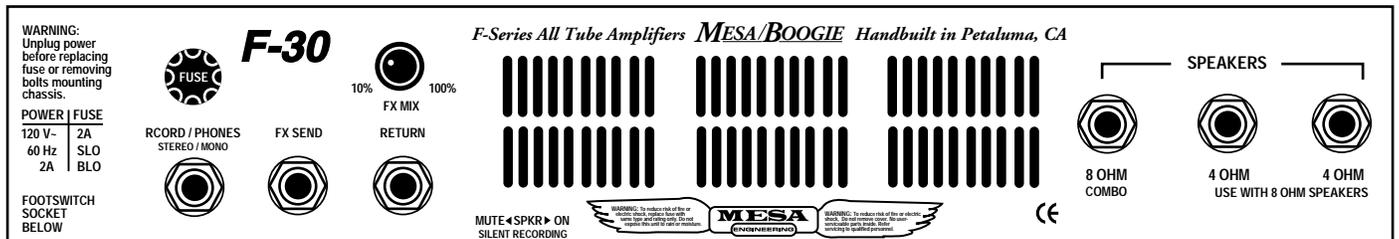
The **F-50** holds the title as middleweight champion of the line with its robust and balanced 2x6L6 power section and this rich, pristine blend speaks from our popular **Wide-Body** 1x12 combo or head. The combo features our favorite custom designed, proprietary Celestion C90 speaker and sounds twice its size as it envelopes you with its 3D magic, while the head through a big cab is absolutely over the top with a tight top end snap and aggressive mid-power urgency.

The big daddy **F-100** is the power broker of this clan with the undeniable authority of 4x6L6's working for your tone. This big block bad boy produces stunning clean headroom and can push some serious air in its 2x12 combo format featuring two Celestion Vintage 30's or, when punishment is required, the Long Chassis head pumping a 4x12...it's the final word in loud. The voice is fatter and a little

FRONT VIEW:



REAR VIEW:



OVERVIEW: (Continued) darker than that of its lower power family members but poses a depth and punch found only in amps of this serious-gigging horsepower range. Our legendary 60/100 switch has been included and allows you to detune the power section to achieve the brighter, more clippable feel of the **F-Series**.

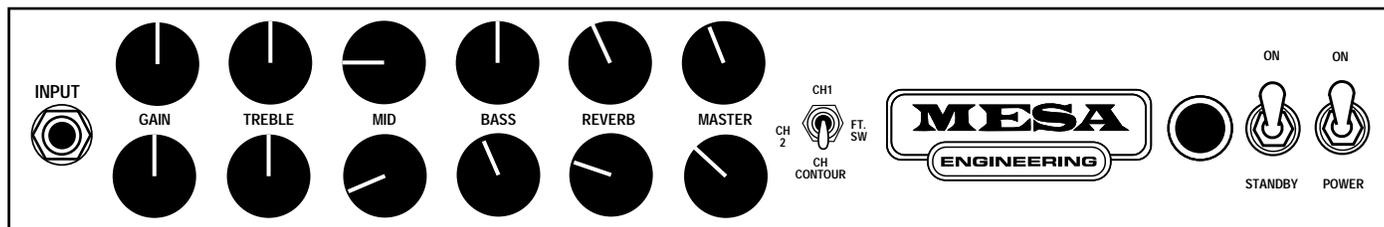
F-Series amplifiers are crafted with the same custom quality, chassis, cabinet and tight tolerance parts found in our top of the line multi-channel amplifiers. They become the deal of the century by focusing on maximum performance derived from a more straightforward layout that defines their stripped, business like personality. Yet make no mistake, these three over the top, footswitchable sounds stand proud against any amp at any price.

Features include 2 Channels which are divided into a separate Rhythm Channel (top) and a Two-Mode Lead Channel (bottom) which shares a set of Tone controls to produce the more vintage, warm sauce of Lead 1 and the huge, aggressive spread of Lead 2 Contour. Add to this a long tank, 3-spring, pure analog Reverb, a Parallel Effects Loop and a dedicated Recording Output and the **F-Series** preamp shines with old world luster as it delivers modern high gain performance.

All this preamp versatility is powered by feeding our dynamic dual differential driver first seen in our popular **Strategy 400 Stereo** power amp, which lends an explosive nature to the sound and gives the impression of headroom far beyond the rated wattage. We then send this super-buffed signal to the output section that responds to every nuance of your playing style.

All this performance is controlled via the included 3 button footswitch and this rounds out the package to achieve a performance minded instrument of ultimate expression. So before we get to the specific controls and features, take a spin around the world of tone found in the 3 Modes using the sample setting below as a guide.

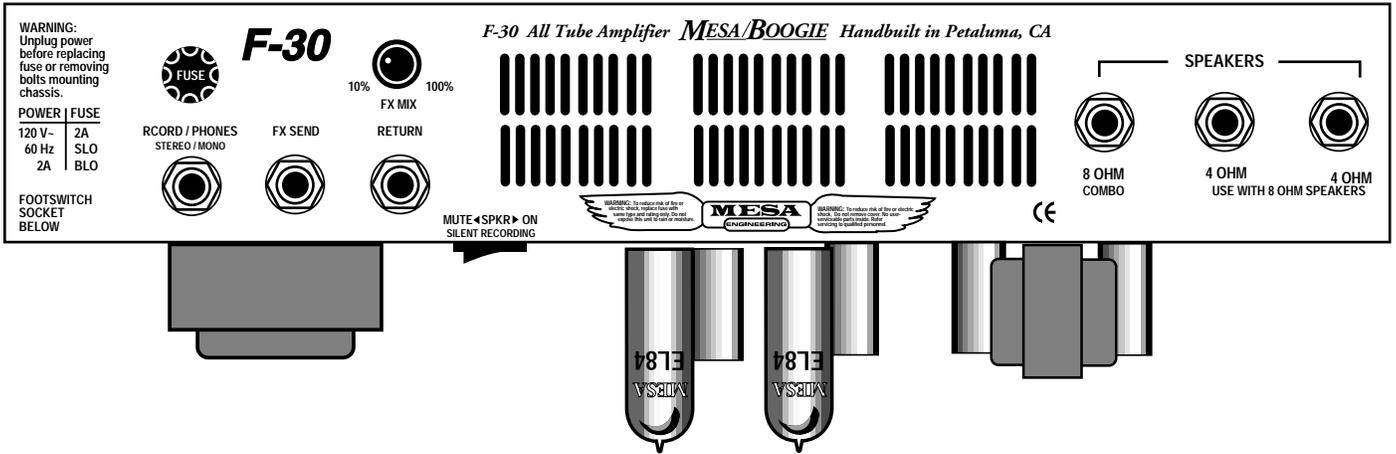
INSTANT GRATIFICATION:



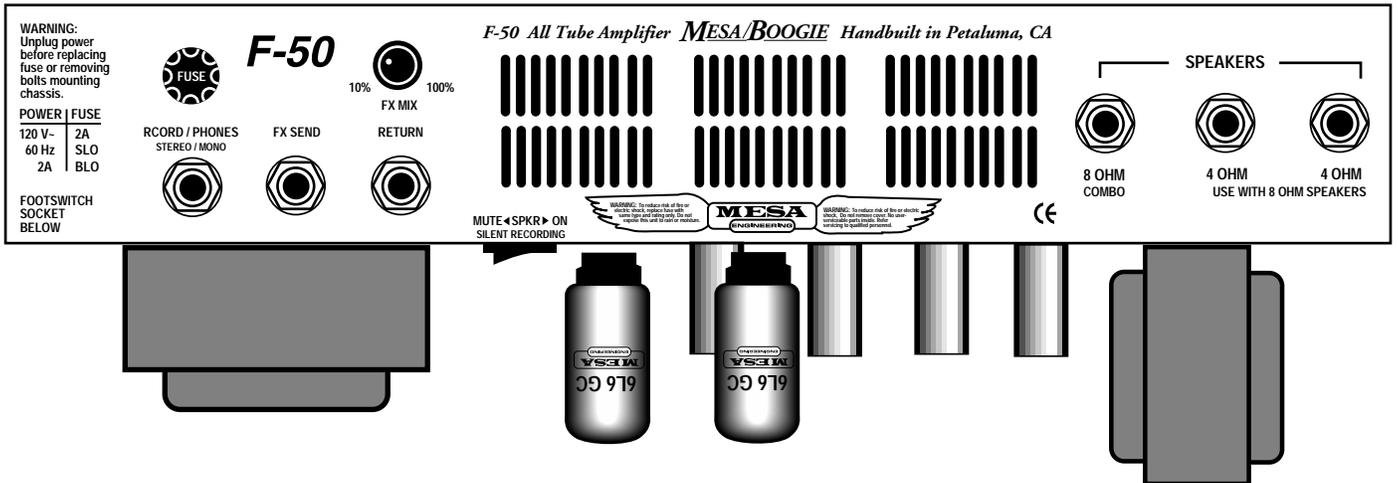
NOTE: To audition the 3 modes using the Footswitch, toggle between Channel 1(top) and Channel 2 (bottom) using the left button and toggle between Lead 1 and Lead 2 Contour with the middle button.

OVERVIEW: (Continued)

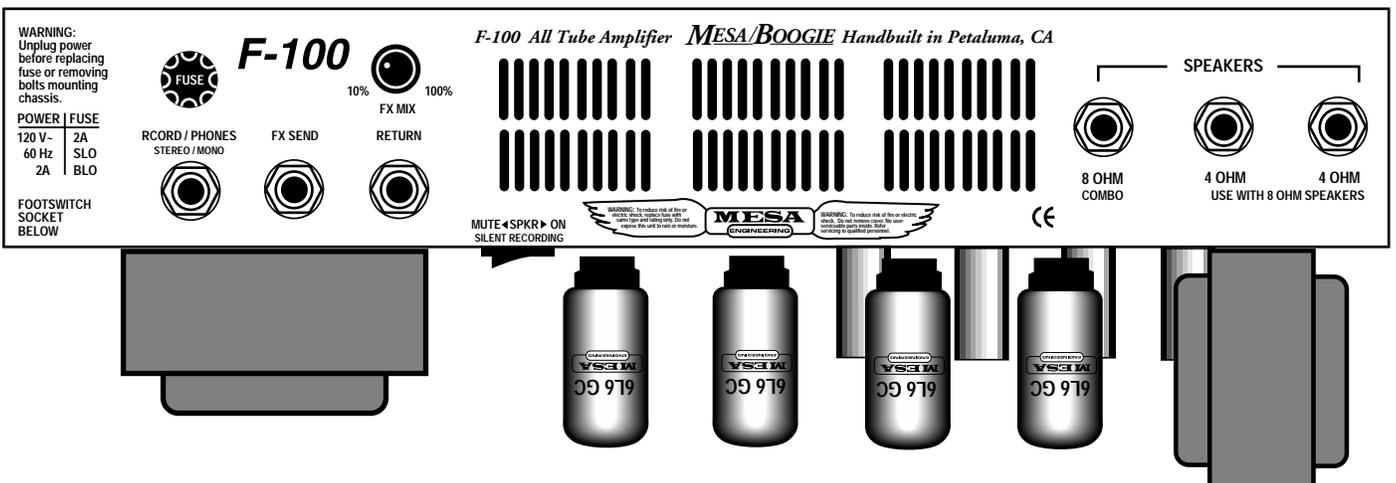
REAR VIEW *F-30*



REAR VIEW *F-50*



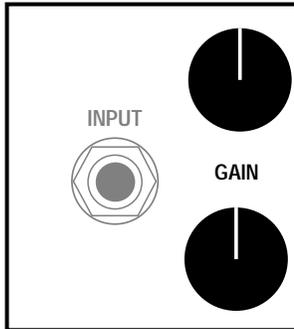
REAR VIEW *F-100*



CONTROLS:

GAIN:

This is by far the most powerful control in each of the three different Modes that are activated by the Mode switch. It not only determines the overall gain amount, shape and sensitivity of the Mode selected...but it is also a powerful Tone control. Generally speaking, whatever is dialed up here ultimately determines the Modes' personality. Set low, it allows cleaner and brighter sounds with enhanced dynamic response, especially in the higher frequencies. Set high, the whole personality of the Mode becomes darker, fatter and more overdriven.

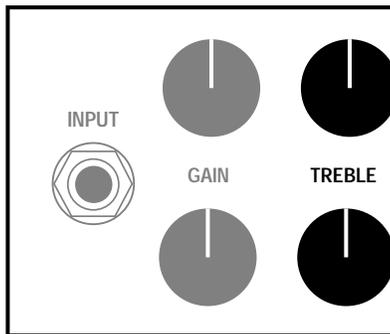


We worked hard to make sure that the entire range of Gain available is usable in the **F-Series** and more importantly, musical. Don't think for a moment that this simple layout limits you in any way in regards to the amount and texture of Gain that is available. Long neurotic hours were spent to ensure that the ranges of Gain were stylistically accurate. It's probably a good time to mention that most of the great sounds can be found in the **F-Series** by setting the GAIN control moderately in the Lead 2 - Contour mode.

In the Channel 1 Mode, try setting this control somewhere between (11:00 through 1:00). Use of moderation here will reduce the likelihood of pesky tube microphonic problems ever occurring, while at the same time making all three Modes easier to balance in volume and FX send strength.

TREBLE:

As in most tube guitar amplifiers, the TREBLE control (in all three Modes of your **F-Series** amplifier) is the most powerful of the rotary controls and is next in line only to the GAIN control as a shaping tool. Because it is first in the signal path of the tone controls - and from here the Middle and Bass receive their signal - it is by far the dominant tone control. For this reason the setting of the TREBLE control is very important for equal representation of the three frequency regions to appear at their respective controls.

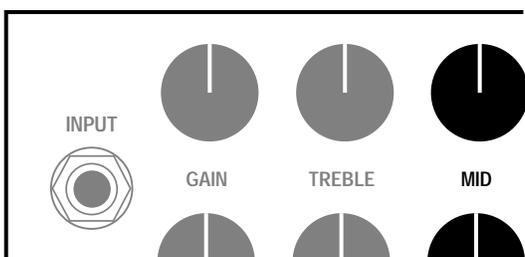


Like most of the controls on your **F-Series** amplifier there is an optimum region of the TREBLE control where ample top end is mixed in and yet enough signal is still passed on to the MIDDLE and BASS controls. As you might surmise, here is the sweet spot. There are definitely great sounds above and below this middle region (11:00 through 1:30), but the balance between the TREBLE control and the other two tone controls is compromised.

The one place you may want to throw caution to the wind and set the TREBLE control above this median zone presents itself in Channel 1 of your new **F-Series** amplifier. The TREBLE control can be used to dump extra gain into the mix. As you might surmise, the BASS Controls' effectiveness will be reduced, so you may have to run a much higher setting than you are used to seeing to achieve a balance. This said, keep in mind that the TREBLE control in Channel 1 should not be set much above (3:30) to avoid unwanted microphonic tube problems.

MID:

The MID control is responsible for the blend of midrange frequencies in the mix and though its effect is not as dramatic as that of the TREBLE control, it plays an integral part in achieving any sound in your **F-Series** amplifier. It is capable of changing the feel dramatically as it blends in a group of frequencies that tend to soften or stiffen the way a sound feels to play.



Most players tend to lean in the direction of lower MID control settings (7:00 through 11:00) where a scoop in this region produces girth (by letting the Bass become a little more dominant) and a lack of punch lends a more com

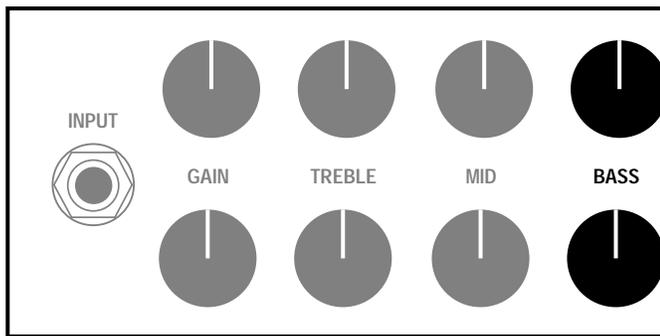
CONTROLS:

MID: (Continued) pressed, even feel to the strings and therefore less apparent resistance to the pick. As the MID control is increased, (11:00 through 11:30), the sound is rounded-out and filled-in with a focused mid attack appearing rather quickly. As you would guess, the feel starts to change - becoming more resistant. Above this region the MID control could be used to compensate for either weaker pick-ups or for times when a specific deficiency is produced by either an extremely high setting of other tone controls, or a physical anomaly in the room. While these MID control settings (2:00 - 5:00) can introduce added gain and create enhanced focus, the trade-off will be a stiffer, more forward, less compressed feel.

BASS:

This control blends in the lower frequencies and its effectiveness, again, depends on the setting of the TREBLE control. It should also be set with moderation, as extreme settings in either low or high directions can produce an unbalanced tone. In any one of the three

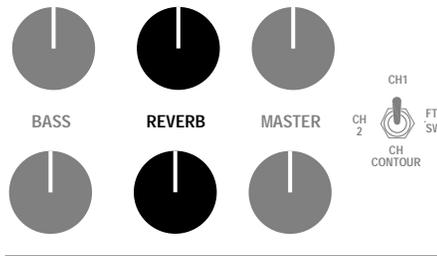
Modes, be especially careful using higher Gain settings. Too much Bass will cause a flabby unfocused sound that can't be dialed out because excessive Bass has been introduced to the pre-amp in the early stages.



Try setting the BASS control to (7:00) for clean sounds in the CLEAN Mode and (4:00) or below when dialing up High Gain overdriven sounds in this Mode. In the Channel 2 / CONTOUR Mode, try setting the BASS somewhere between (10:00 through 2:00). These settings will depend upon the amount of Gain and Treble that you have dialed up.

REVERB:

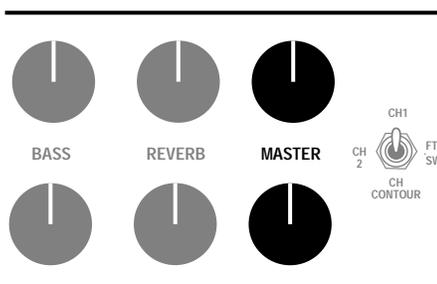
Your new **F-Series** amplifier is equipped with a rich, natural sounding analog Reverb circuit. The REVERB control enables you to dial-in just the right amount of Reverb to be mixed with the dry signal. It is normal for extreme settings of the REVERB control to slightly alter the character of the amplifier as the voicing of the Reverb circuit becomes more dominant in the mix.



NOTE: Avoid using high setting the REVERB control when High Gain and Treble settings are in use. This reduces the likelihood of annoying microphonic problems occurring.

MASTER:

The individual MASTER controls serve three purposes in the layout of the **F-Series**. FIRST: They serve as level balancing controls for each of the two channels. This enables a wide range of front end Gain settings to be matched to a given listening level and the level of the other Modes.



SECOND: They act as Effect Send controls for each Mode in the Effects Loop. As with many of the controls on the **F-Series**, the best results for balance and tone are usually found in the medium range of this control.

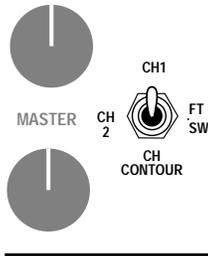
THIRD: The MASTER control is the Record / Phones Send Level control. When using the direct RECORD / PHONES jack found on the Rear Panel to interface di -

CONTROLS:

MASTER: (Continued) -rectly to a mixing board or recorder, this control will determine the amount of signal you will be sending via this jack. In this application it is usually best to start with the MASTER controls set to (7:00) and gradually increase them to the proper level. This minimizes the possibility of blowing speakers or eardrums in the event the engineer has an extremely sensitive input headroom setting in place at the console.

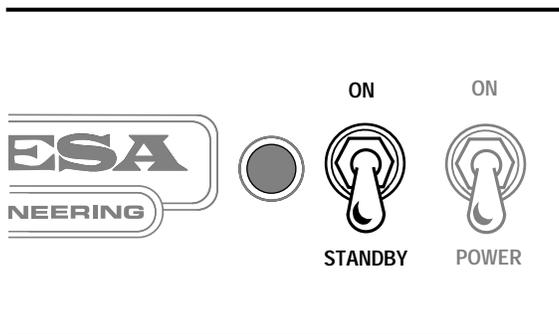
CH.1 / CH.2 / CONTOUR SELECT SWITCH:

Use this mini-toggle to select one of the three Modes - CHANNEL 1, CHANNEL 2 or CONTOUR. In order for the channel select Footswitch to operate when connected to your new **F-Series** amplifier, the channel select mini-toggle switch must be in its middle position - FT . SW.



ON / STANDBY:

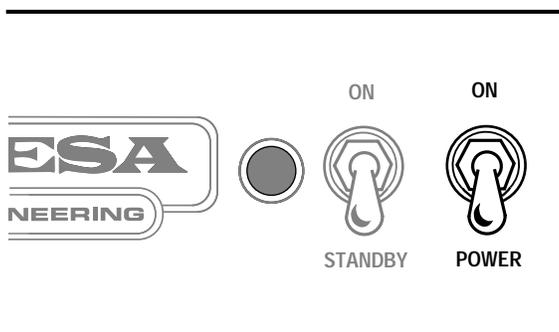
Perfect for set breaks...this toggle switch also serves an even more important purpose. In the STANDBY position (switch up), the tubes are at idle so that during power up they may warm up before being put to use.



Before the power is switched on, make sure the STANDBY switch is in the STANDBY position. Wait at least 30 seconds and then flip the STANDBY switch to its ON position. Following this simple warm up procedure helps in preventing tube problems and increase their toneful life substantially.

POWER / ON:

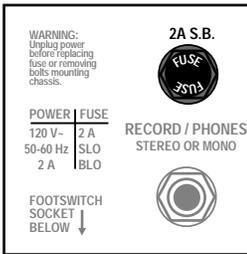
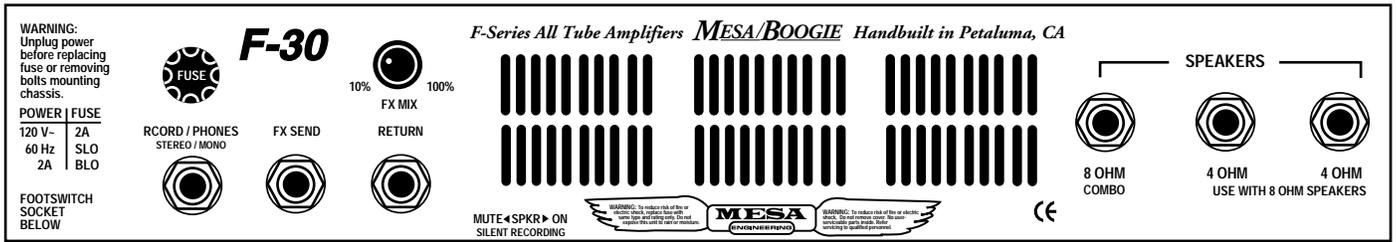
This switch delivers the A.C. power to the **F-Series**. Make sure the unit is properly grounded (all three terminals of the A.C. power cord must be connected whenever possible and that the proper voltage is present. Follow the cold start procedure described in the ON/ STANDBY section above when powering up your new **F-Series** amplifier.



NOTE: Never alter the A.C. power cord in any way.

REAR PANEL:

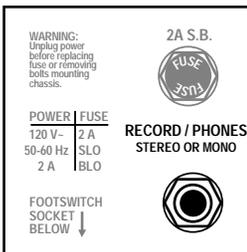
REAR VIEW:



FUSE:

This is the A.C.'s (Alternating Current) main fuse and provides protection from outside A.C. fluctuations, as well as power tube failure damage. Should the FUSE blow, replace it with the same rating in a slo-blo type package. The domestic U.S. version requires a 2 Amp SLO-BLO FUSE. A power tube short or failure is often the cause of a blown fuse...Follow the cold start procedure mentioned earlier in the ON / STANDBY switch section and watch the power tubes as you flip the STANDBY to the ON position. If a power tube is going bad or is arcing you will see it! Flip the STANDBY switch to STANDBY immediately and replace the faulty power tube and the fuse if necessary. If you see nothing abnormal as you lift the STANDBY switch, it is possible that a power tube shorted temporarily and blew the FUSE. If this is the

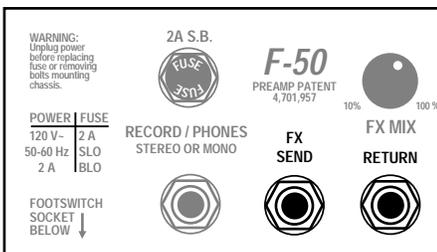
case it may work again normally. To be extra safe you may want to replace all power tubes in the troubleshooting tradition and save the replaced set as spares. Carry along a few extra fuses for they too could be worth their weight in gold some day.



RECORD / PHONES:

This jack provides direct-to-console interfacing for recording or sound reinforcement applications. It can also be used to power a set of personal headphones which is a convenient way to practice day or night privately. It is a circuit dedicated to reproducing the roll off that occurs in the output section with a speaker connected.

The send level strength is determined by the GAIN and MASTER controls. From this jack, adequate signal level will be available to you for most of your recording needs and live direct performances.



FX LOOP: SEND & RETURN

These two 1/4" jacks are the patch point for external effects. The Effects Loop is wired in parallel with the normal signal. Connect the SEND jack of the **F-Series** to your Effects Input jack. Connect the RETURN jack of the **F-Series** to the Output jack of your effect unit. The Effects Loop is a patch point between the pre-amp and power section. Therefore, the RETURN jack can double as a "Power Amp Input" jack.

When the RETURN is used as an input, the **F-Series** FX MIX control is the only control being utilized regardless of the mode selected and should be set to 100%. While the RETURN is being used in this manner, all other controls are inactive.

REAR PANEL:

FX MIX:



This control determines the dry/wet blend of the FX Loop signal in relation to the unaffected signal. Set to 10% you will experience only the dry signal (no noticeable FX) and at a setting of 90% the entire signal will be wet (total effect.)

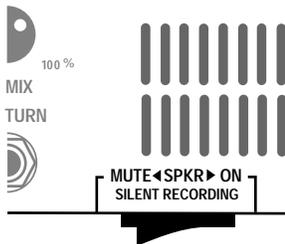
RETURN



For the best results...Set the mix of your effect to 100% wet. Then dial in the amount of effect that you wish to hear, starting at 10% with the FX LOOP MIX control. The drier (closer to 10%) signal you use, the better your tone should be. This parallel type FX Loop allows the amplifier to retain its purity with the smallest amount of degradation

due to possible effect impedance mismatching.

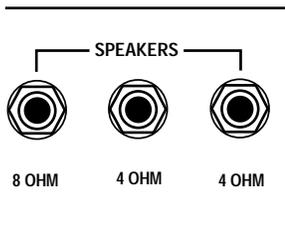
SILENT RECORDING:



This rocker switch which is located down under the chassis and selects between the live "Speaker On" setting and the silent "Speaker Mute" setting. This is a perfect solution for all-nighters! This switch mutes all of the signal at the power section driver stage, removing the need for a speaker load IN THIS POSITION ONLY!

NOTE: When this switch is set to the "ON" position, a speaker load must be maintained by either a load resistor of some type or a speaker itself. Failure to follow this instruction could result in major damage to the amplifier. Leave your speaker connected.

SPEAKERS:



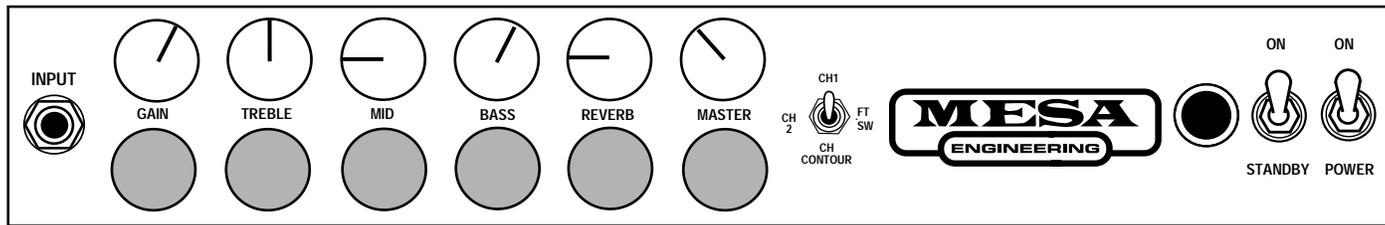
Sensitivity to speaker mismatching in regards to ohmage differences is low, hence no damage to the amplifier will occur. However, very low ohmage loads will cause the power tubes to wear faster. The **F-Series** are equipped with a single 12 inch 8 Ohm speaker, but as you can see, other speaker configurations may be used. When using two 8 Ohm speakers, connect each of them to the 4 Ohm speaker jacks that are provided, this will equal a 4 Ohm load which is the proper impedance required when using this particular speaker configuration.

4x12 cabinets may be 4, 8 or 16 Ohms. If you are not sure of the impedance of your cabinet, you may need to remove the Rear Panel in order to verify the impedance rating of the individual speaker or speakers. **Mesa/Boogie** 4x12 and 4x10 cabinets come standard wired to 8 Ohms, and are wired in series-parallel.

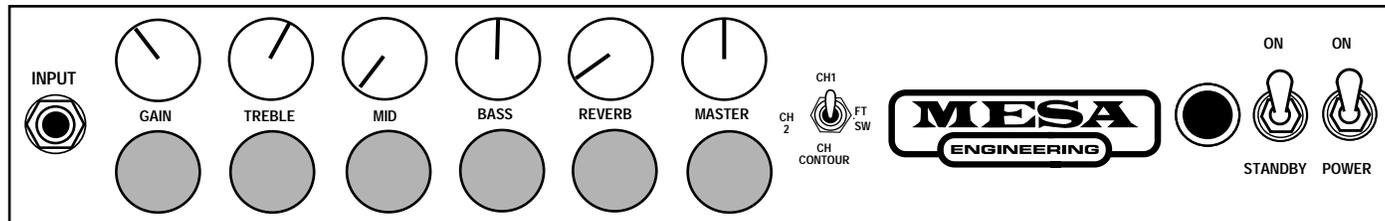
Some Non-**Mesa** 4x12 cabinets are wired 16 Ohms using four 16 Ohm speakers. By wiring all four speakers in parallel, you can reduce the cabinet to an impedance load of 4 Ohms (assuming the speakers are 16 Ohms each.) No matter how unusual your speaker setup, it is always possible to get good performance.

FACTORY SAMPLE SETTINGS

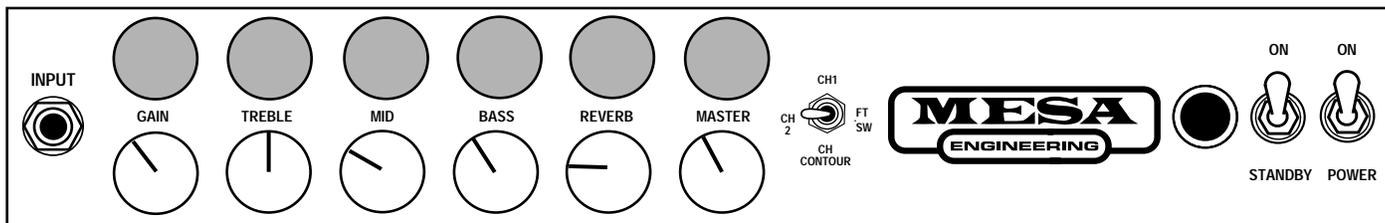
Sample #1 Fat Clean: Channel 1



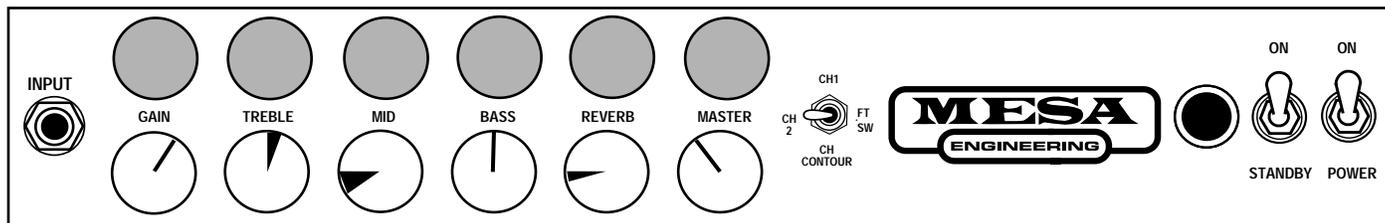
Sample #2 Squeaky Channel 1



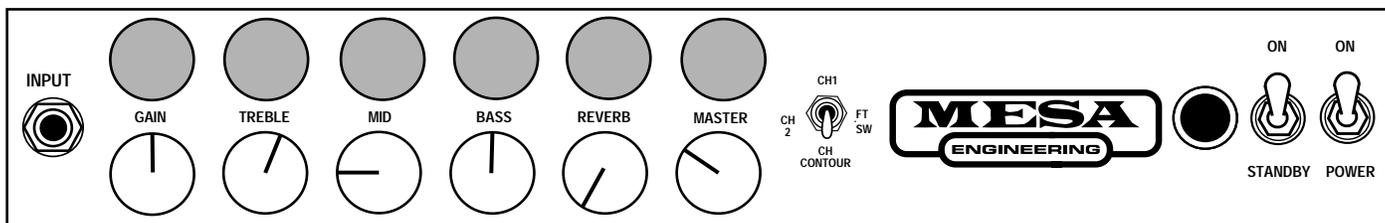
Sample #3 Blues Power: Channel 2



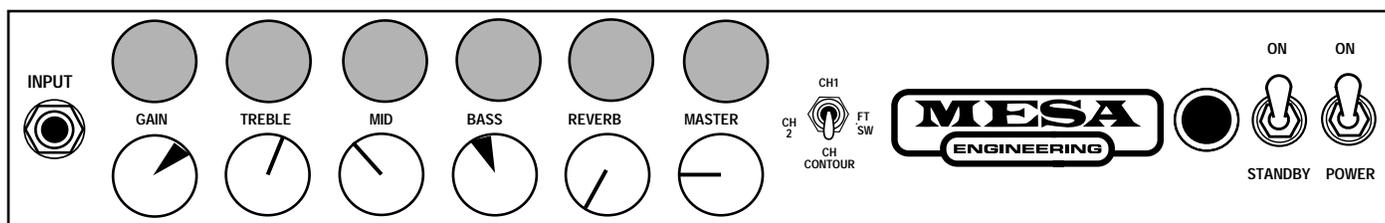
Sample #4 Liquid Solo: Channel 2



Sample #5 Huge Crunch: Channel 2 Contour

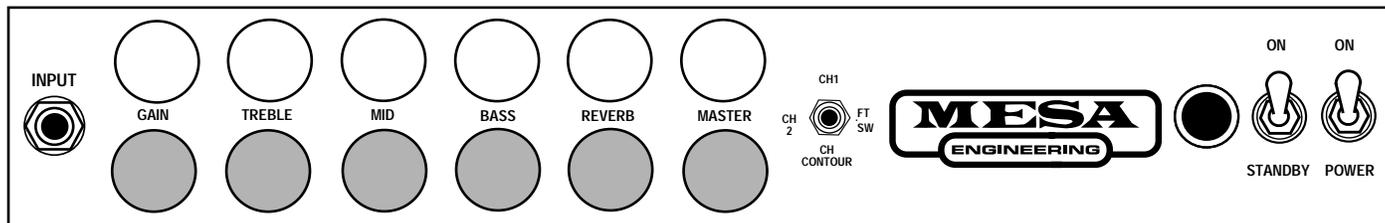


Sample #6 Insane Lead: Channel 2 Contour

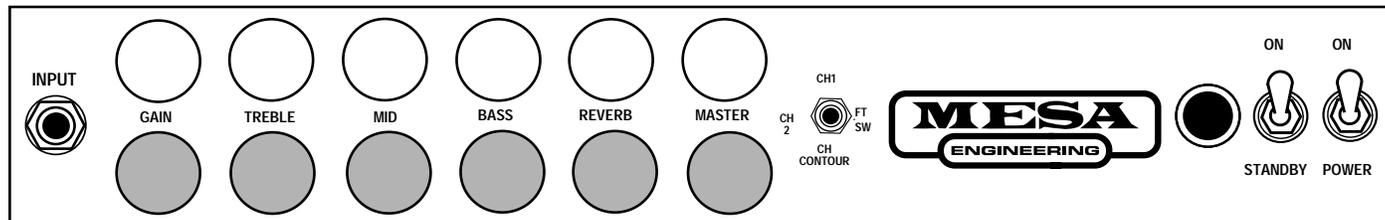


PERSONAL SETTINGS

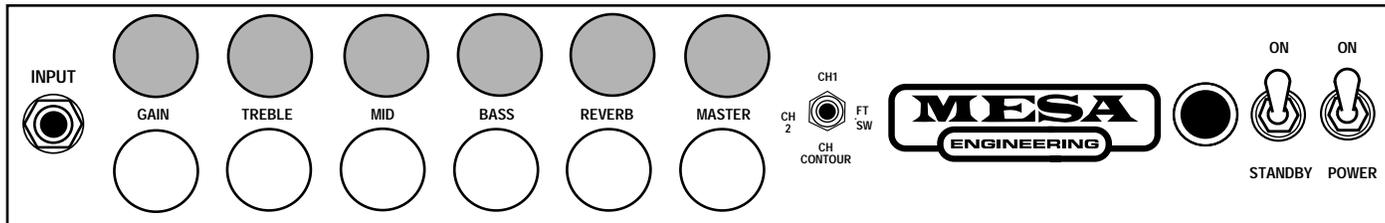
Sample #1



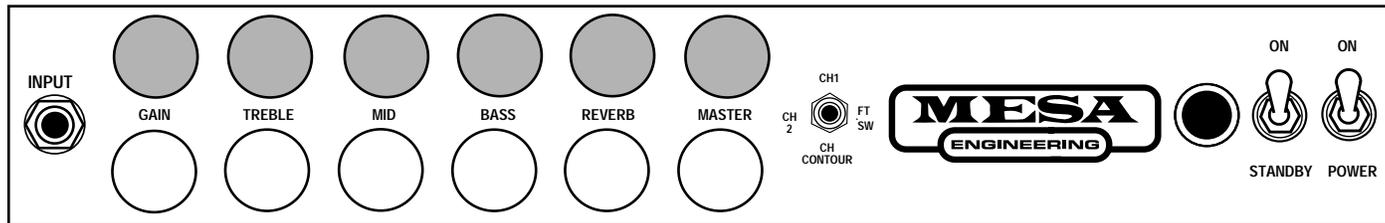
Sample #2



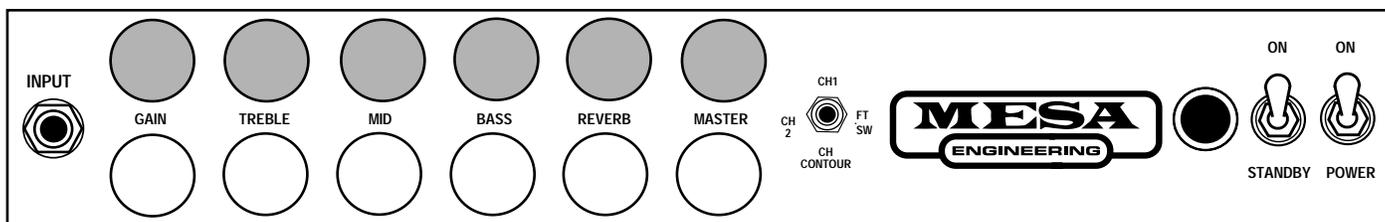
Sample #3



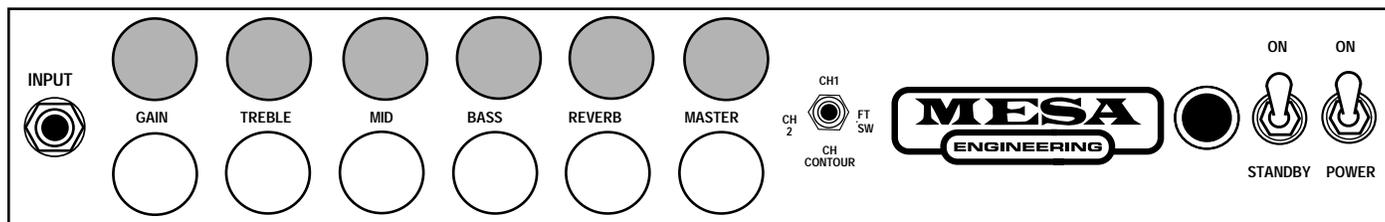
Sample #4



Sample #5

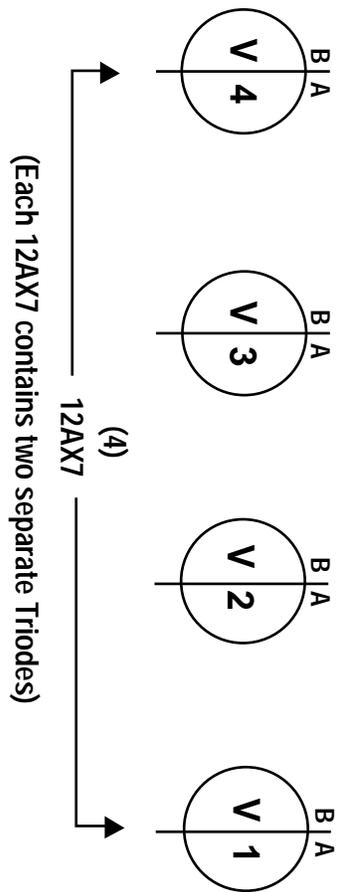
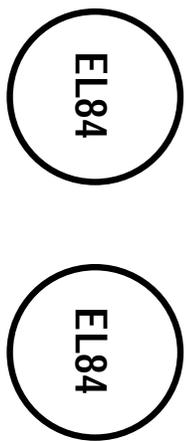
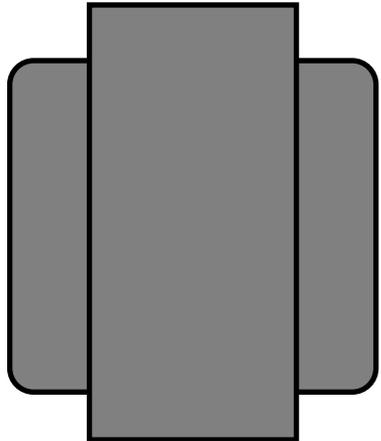
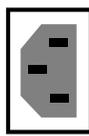


Sample #6





MUTE SWITCH

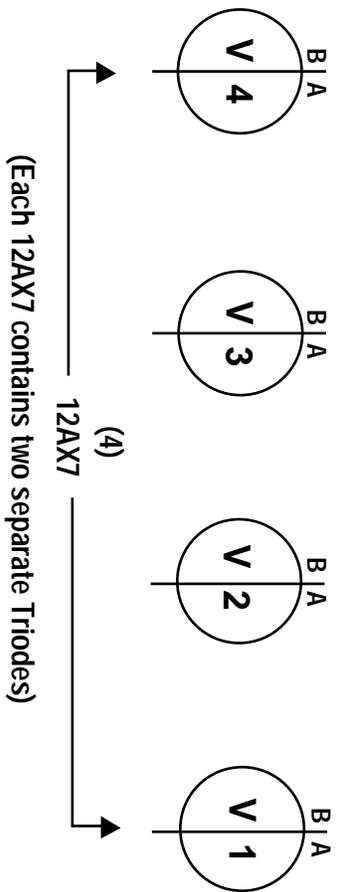
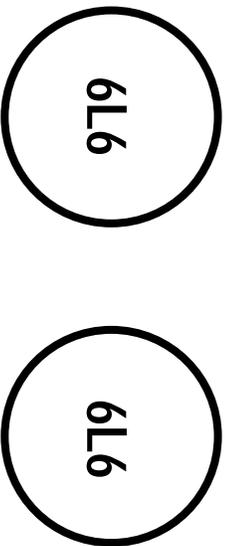
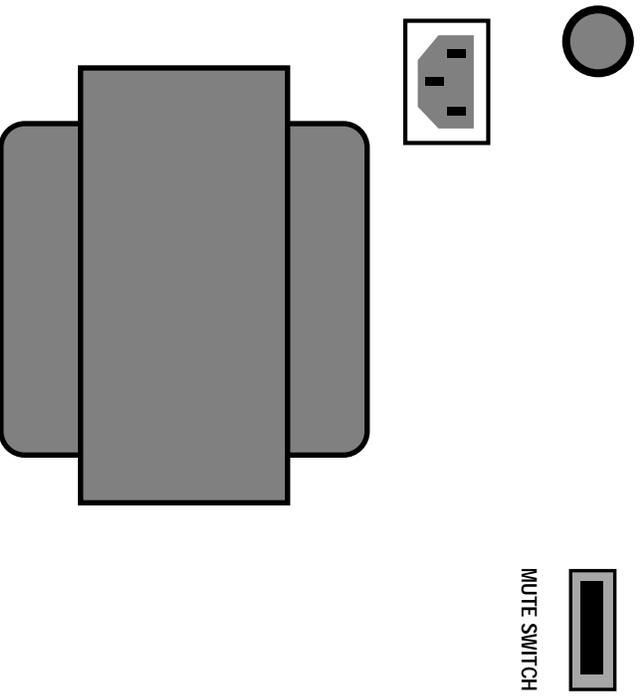


PARTIAL VIEW OF CHASSIS

Description of Tube Functions

- V1 A= Input Stage both Channels
- V1 B= Clean Channel
- V2 A= 2nd Input Stage bothChannels
- V2 B=Channels 2 & 3 Boost Stage
- V3 A=Channels FX Send

- V3 B= FX Return
- V4 A= Phase Splitter /
- V4 B= Output



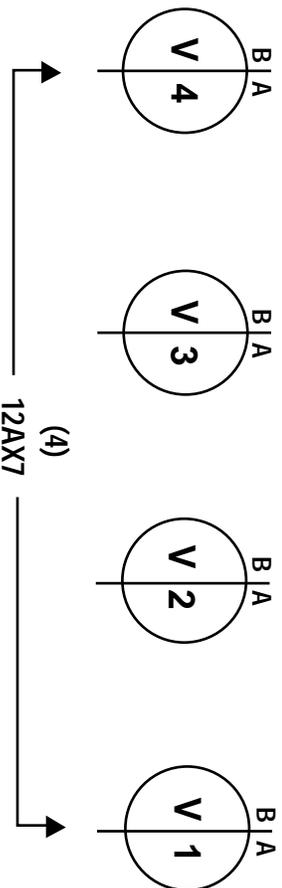
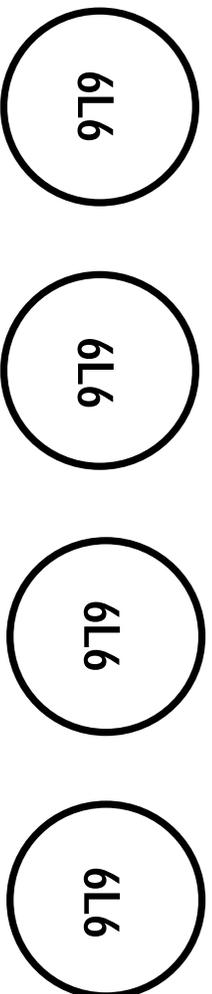
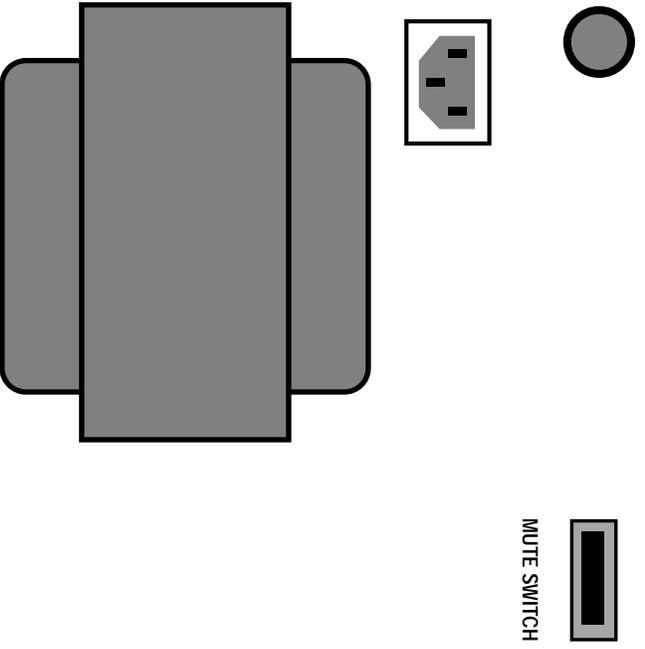
PARTIAL VIEW OF CHASSIS

Description of Tube Functions

V1 A= Input Stage both Channels	V3 B= FX Return
V1 B= Clean Channel	V4 A= Phase Splitter /
V2 A= 2nd Input Stage bothChannels	V4 B= Output
V2 B=Channels 2 & 3 Boost Stage	
V3 A=Channels FX Send	

F-100 TUBE TASK CHART

BACK EDGE OF CHASSIS



PARTIAL VIEW OF CHASSIS

Description of Tube Functions

- V1 A= Input Stage both Channels
- V1 B= Clean Channel
- V2 A= 2nd Input Stage bothChannels
- V2 B=Channels 2 & 3 Boost Stage
- V3 A=Channels FX Send
- V3 B= FX Return
- V4 A= Phase Splitter /
- V4 B= Output

TUBE NOISE & MICROPHONICS:

You may occasionally experience some form of tube noise or microphonics. Certainly no cause for alarm, this quirky behavior comes with the territory and the Tone. Much like changing a light bulb, you don't need a technician to cure these types of minor user serviceable annoyances and in fact, you'll be amazed at how easy it is to cure tube problems...by simply swapping out a pre-amp or power tube!

First may we suggest that you set the amplifier up on something so that you can get to the tubes comfortably without having to bend down. It also helps to have adequate lighting as you will need to see the tube sockets clearly to swap tubes. Use caution and common sense when touching the tubes after the amplifier has been on as they may be extremely hot! If they are hot and you don't want to wait for them to cool off, try grasping them with a rag and also note that the glass down around the bulbous silvery tip is considerably less hot which makes it easier to handle. Gently rock the tube back and forth as you pull it away from its socket.

DIAGNOSING POWER TUBE FAILURES:

There are two main types of tube faults: shorts and noise. Both large and small tubes may fall prey to either of these problems but diagnosis and remedy is usually simple.

If a fuse blows, the problem is most likely a shorted power tube and shorts can either be mild or severe. In a mildly shorted tube the electron flow has overcome the control grid and excess current flows to the plate. You will usually hear the amp become distorted and begin to hum slightly. If this occurs, quickly look at the power tubes as you switch the amp to STANDBY and try to identify one as glowing red hot. It is likely that two of a pair will be glowing since the "shorted" tube will pull down the bias for its adjacent mates, but one tube may be glowing hotter — and that one is the culprit. The other two are often fine — unless they've been glowing bright red for several minutes.

Because there is no physical short inside the tube (just electrons rioting out of control) merely switching to STANDBY for a few moments then back to ON will usually cure the problem...at least temporarily. Watch the tubes carefully now. Should the problem recur, the intermittent tube will visibly start to over heat before the others and thus it can be identified. It should be replaced with one from the same color batch, shown on its label. Call us and we will send one out to you. The severe short is not nearly so benign. In the worst cases, a major arcing short occurs between the plate and the cathode with visible lightning inside the glass and a major noise through the speaker. If this is seen to happen, IMMEDIATELY turn the amp to STANDBY. By this time the fuse probably will have blown. Such a short is usually caused by a physical breakdown inside the tube including contaminate coming loose or physical contact (or near contact) between the elements. Replace it and the fuse with the proper slo-blo type and power up the amp using the power up procedure as we described earlier in this manual.

TUBE NOISE:

Often caused by contamination within in a tube, the culprit can usually be identified, and by lightly tapping on the glass, you will probably hear the noise change. Hearing some noise through the speakers while tapping on the 12AX7's is normal however. And the one nearer the INPUT will always sound louder because its output is being further amplified by the second 12AX7.

The power tubes should be all but quiet when they are tapped. If crackling or hissing changes with the tapping, you have probably found the problem. To confirm a noisy power tube, merely put your **F-Series** amplifier on Standby, remove it from its socket and turn it back on. It will cause no damage to run your amplifier briefly with one power tube missing. You may notice a slight background hum, however, as the push-pull becomes unbalanced. Whenever you are trying to diagnose a suspect tube, keep your other hand on the POWER and STANDBY switches ready to shut them off instantly in the unlikely case you provoke a major short.

If you think you've located a problem tube but aren't sure, we recommend substituting the suspect with a new one just to be sure of your diagnoses. You will be doing yourself and us a big favor by just following the simple guidelines previously mentioned regarding tube replacement. You'll probably be successful with much less effort than is required to disconnect everything and haul the unit to a technician who will basically perform the same simple tests. If the tubes are still within their six-month warranty period, we will happily send you a replacement. Just note the color designation on the tube label so that we can send you the appropriate match.

DIAGNOSING PREAMP TUBE PROBLEMS:

Because your amplifier is an all tube design, it is quite possible that you will at some point experience minor pre-amp tube noise. Rest assured - this is no cause for alarm and you can take care of the problem yourself in a matter of minutes by simply swapping tubes.

Let us begin by saying; It is a "very good" idea to keep at least a couple of spare pre-amp tubes on hand at all times to insure uninterrupted performance. These minor pre-amp tube problems can take many forms but can generally be described in two categories: Noise and Microphonics. Noise can be in the form of crackling, sputtering, white noise/hiss and/or hum. Microphonic problems usually appear in the form of a ringing or high pitched squealing that gets worse as the gain or volume is increased thus are more noticeable in the higher gain "HI" modes. Microphonic problems are easily identified because the problem is still present even with the instruments' volume off or unplugged altogether - unlike pick-up feedback which ceases as the instrument is turned down. Microphonic noise is caused by mechanical vibration and shock: think of banging a microphone around and you'll understand where the word came from.

The best way to approach a pre-amp tube problem is to see if it occurs only in one specific mode or channel. Then refer back to the TUBE TASK and DESCRIPTION CHART and it should lead you to the tube needing replacement. Then all that remains is to swap the suspect tube for a known good performer.

If you cannot narrow down the trouble to a specific mode or channel, the problem may be the small tube that drives the power tubes which is operational in all modes and channels. Though rare, a problem with the driver tube would show up in all aspects of performance - so if you can't narrow the problem down to being mode or channel specific, you may want to try replacing the driver tube. Driver problems generally show themselves in the form of crackling or hum in all modes of performance and/or weak overall output from the amplifier. Occasionally an anemic driver tube will cause the amplifier to sound flat and lifeless, but this is somewhat uncommon, as worn power tubes are a more likely suspect for this type of problem.

Sometimes making the diagnosis is more trouble than it's worth and it's faster and easier to merely replace the small pre-amp tubes ONE AT A TIME with a replacement known to be good. But MAKE SURE you keep returning the tubes to their original socket until you hit the one that cures the problem. You'll notice that tubes located nearer to the INPUT jack always sound noisier...but this is because they are at the start of the chain and their noise gets amplified over and over by the tubes that follow. The tube that goes into this "input socket" (usually labeled V1) needs to be the least noisy of the bunch. The tube that goes at the end of the preamp chain - just ahead of the power tubes - can be quite noisy without causing any problem at all. The tubes in your amp have already been located in the most appropriate sockets and this is why you should NEVER pull them all out at once and ALWAYS swap them one at a time. ALWAYS return a perfectly good tube to its original socket. Also it's a good idea to put the amp on STANDBY when swapping tubes to reduce the heat build up in the tubes themselves and to prevent explosive noises (which can still occur even if you are pulling the tubes away from their sockets gently) from coming through the speaker.

Remember, take your time, be patient and chances are real good that you can fix your amp yourself by finding and replacing the bad tube. It kills us to see someone who has shipped their amp back to us...and all it needed was a simple tube replacement! If you must send back your amp, unplug the power cord, speaker and reverb cables then remove the chassis from the cabinet by unscrewing the four mounting bolts on top. The chassis then slides back like a drawer and comes out. Remove the big power tubes and mark them according to their location from left to right 1, 2 etc. They need to be wrapped separately with plenty of wadded up newspaper around them and put in a smaller box within the larger carton. To wrap the chassis, use plenty of tightly wadded up newspaper so there is at least six inches of "crush space" between the chassis and the cardboard box. Bubble wrap also works well, but please DON'T use styrene peanuts - they will shift during transit and get lodged inside your electronics as well as allowing your amp to end up at the bottom of the box unprotected and possibly damaged. Pre-amp tubes don't normally wear out as a rule. Therefore, it is not a good idea to change them just for the sake of changing them. If there isn't a problem - don't fix it. If there is no result from your substitutions, it may be possible that you have more than one problematic tube. Though rare, this does happen and though it makes the troubleshooting process a little more intimidating, it is still possible to cure the problem yourself.

NOTE: It is normal to hear a slight metallic ringing sound when tapping on the preamp tubes. As long as the tube does not break

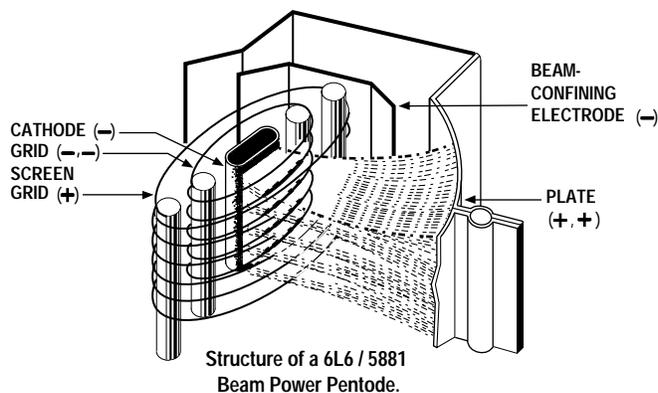
into oscillation or start crackling or any other form of bizzare noise, it is considered normal and functional.

BIAS ADJUSTMENT: (a continuing series)

NOTE: An article written by Randall Smith that we thought you might find interesting.

Here's a question we often hear:

"Why doesn't **Mesa** put bias adjustments in their amplifiers?"



Well, there's a short answer and a long answer to this question.

The short answer is that during my 12 years of repairing Fenders, one of the most frequent problems I saw was bias controls that were either set wrong or that had wandered out of adjustment due to vibration. As any honest tech will tell you, there's lot's of easy money to be made by sprinkling "holy water" on amplifiers ... uh, what I meant to say is "Your amp needed biasing." See what I mean? What customer is going to argue with that?

It only takes a moment and a volt meter: The Fender diagram shows how: "Adjust this trim pot for - 52 volts." That's it. Nothing more.

Now don't be fooled into thinking that tubes "draw" more or less bias, they don't. The way a bias supply is connected to a tube is akin to a dead end road, it just trails off to nowhere without really completing a circuit. It's a static voltage and regardless of what tube is in the socket — or even if the tubes aren't plugged in at all, it doesn't change the bias voltage a bit.

So the end of the short answer is this: Since a bias supply needs to put out the right voltage and never vary, I wanted to build amplifiers that were individually hard wired to the correct values and NEVER needed adjustment. And for 25 years, that's how **Mesa/Boogies** have been built.

Time to change tubes? Just plug our tubes into any one of our amps and you're DONE. No tech needed. NO bills and no BS about biasing. And most important: The bias is RIGHT because it can't change!

Now, you want the long answer? Here's more information on how our hard-wired bias avoids trouble. Please read on.

But first, let's make an important distinction. Our business is designing and building high performance amplifiers. And for this we need tubes whose variance is within a narrow range. Our warehouse is full of rejects ...oh, they work — they just don't perform within our tolerance range. We have a very sophisticated computer - based tube testing system (nicknamed "Robotube") that matches and measures tubes over seven important parameters. It can even predict which tubes are likely to have a shortened lifetime — even though they work perfectly during the test.

Because our business is building quality amps, we can afford to reject a lot of wayward tubes. The guys you hear complaining because **Boogies** don't have bias adjusters are primarily in the business of selling tubes - not amps. They don't want to throw away 30 percent of their inventory, so they promote the idea that tubes outside our parameters can be used to "customize" amplifiers and they criticize us because our amps can't be adjusted to accommodate their out-of-**Mesa** tolerance tubes.

Now you might be thinking, "But I thought you just said that tubes don't "draw" bias, therefore they don't effect the bias supply and thus

it doesn't need to be adjustable."

BIAS ADJUSTMENT: (Continued) When you set the bias (whether it's by selecting the right resistors, as we do, or adjusting a trimmer — which is quicker) what you are doing is establishing the correct amount of idle CURRENT that flows through the power tubes. But you can't adjust the current directly, you can only change it by adjusting the amount of bias VOLTAGE that goes onto the tubes' control grids.

Voltage and current are NOT the same. Current is the AMOUNT of electricity, the "quantity" — and is measured in amperes. Voltage is the degree of electric charge — like the "pressure" to use the old water analogy. Let me illustrate how different voltage and current are:

When you scrape your feet across a carpeted floor in dry, wintery conditions, your body can become charged with 50,000 to 100,000 volts of static electricity. And when you reach for the door knob, a spark jumps and you feel it! The voltage is super high but the current (measured in micro-amps) is tiny - otherwise you would die from electrocution.

Contrast this with your car battery, which puts out a mere 12 volts. You can lay your hands right across the terminals and not feel a thing. Yet the amount of current available can run to several hundred amperes .. enough to turn over a cold engine and get it started.

So current and voltage are two totally separate electrical parameters — though when you multiply them together, you get POWER, which is measured in watts.

When you set the bias of an amplifier, you are adjusting the static VOLTAGE at the control grid of the tube in order to produce a desired amount of idle CURRENT flowing to the tube's plate. A small change in grid voltage, produces a large change in the amount of current flowing — and that's basically how a tube works. Say that again because it's super important: A small change in voltage at the grid causes a large change in current flowing to the plate. See, that's the essence of amplification: A small change causing a large change. And here it's a small voltage change causing a large current change.

The bias conditions are what determines how much current flows through the big power tubes when you're not playing. And what drives your speakers is fluctuations in that current flow when are ARE playing. If the amount of current increases and decreases 440 times per second, then you'll hear an A note. If the fluctuations in current flow are large and still at 440 per second, you'll hear an A that is LOUD!

But for purposes of biasing, it's the amount of "plate current" flowing with no signal applied that's important. Unfortunately current is hard to measure because the circuit must be interrupted — as in "cut the wire" — and the meter spliced "in series" with the broken circuit. But measuring VOLTAGE is easy. It is not necessary to interrupt the circuit because a voltage reading can be taken in PARALLEL with the circuit intact.

Thus, as a matter of convenience, most bias settings are given in volts at the grid ... even though current through the plate is the important factor. In fact plate current is so inconvenient (and dangerous) to measure that Fender doesn't even state what the correct value should be. They only give the grid voltage that will produce that current. (That's the minus 52.) But that only happens if the tubes being used are "in spec."

As long as the tubes ARE "in spec", the right bias voltage will always give the correct plate "CURRENT" — but then there's no need for the bias voltage to be adjustable!

If the tubes are NOT in spec, then the only proper way to re-set the bias is to cut the circuit and measure the current while adjusting the bias ... but no manufacturer I know even STATES the desired current value! Be that as it may, when the original bias voltage is altered far enough, it will compensate for the tube's abnormal performance and the correct amount of idle current flow may then be restored. Clearly this is something most repair techs should not attempt.

Some newer amps have LED indicators connected to the circuit which will turn on when the right threshold of current flow has been reached. This is an improvement, and almost worthy if you're willing to except resistors and lights added into your amplifier's audio path — which we aren't. The other "advantage" of this system is that it allows some amp manufacturers to avoid matching their power tubes. The thinking is that adjusting the bias to each tube ~~separately~~ eradicates the inherent differences between the tubes by insuring that the same current flows through each one.

"

BIAS ADJUSTMENT: (Continued) tubes. The thinking is that adjusting the bias to each tube separately eradicates the inherent differences between the tubes by insuring that the same current flows through each one. Again, this has some merit .. but it's still not as good as using tubes that are matched in the first place because compensating for the mis-match causes the push-pull circuit itself to become unbalanced. Two wrongs don't really make a right.

Some of the other recommended biasing, "methods" — such as -" .. tubes running red hot, increase the bias .. sounds harsh and runs too cool, turn it down ..." are guesswork at best. Luckily, one of the great things about tube amps is that they can usually stand some abuse without causing any real harm ... at least not immediately.

But don't these alterations imply that you are second-guessing the amp designer and that there's a better set of operating conditions that the designer missed but the tube sellers have discovered?

Now some players may like the sound of their amp altered by tubes with extreme characteristics and with the bias set to help compensate. But often it is the mere novelty of change that they're really responding to and when the amp goes back to the proper original way, we've seen them be far happier still!

Because every part in every one of our designs has been meticulously evaluated, compared and stressed over — no matter how seemingly insignificant it might be. And with every design we look for a "sweet spot" where all the parameters — including the bias — come together to give the best sonic performance, consistently and reliably. Every part and voltage is important — yet no one complains that these other parameters aren't available for tinkering.

Consider our patented **Simul-Class** circuitry where there are two different bias voltages used for separate pairs of power tubes ... and changing one voltage also changes the other. Great care goes into getting this just right and we think we'd be asking for trouble to have it adjustable for the world to play with ... unless you like paying to have your amp messed up. Sorry, I meant to say, "Uh, ... your amp needed biasing."

If that doesn't appeal to you, then merely plug a matched set of **Mesa** tubes into one of our amps and you're ready for tone. Guaranteed. You'd be amazed at the number of service calls we field every day that lead to a diagnosis of out-of-tolerance, non-spec tube problems. To think these would be prevented by including a bias adjustment is something of an insult to you and us. If you put the wrong size tires on your car, do you think changing the pressure will make them right?

Please, don't think this is a blanket indictment of the other guys selling tubes — it isn't. And their tubes aren't all bad either. It just doesn't make sense to pay more of your hard earned cash for tubes that were probably made in the same Russian or Chinese factory and which have the possibility of being outside the performance window we select for your amp. And it pains us to hear the hype and mystique built up around biasing when twenty-five years of evidence affirms our decision to make bias circuits that "never need adjustment". How much money and trouble that has saved **Mesa/Boogie** players you couldn't estimate.

Our rigorously tested and hand selected tubes are available at your nearest **Mesa/Boogie** Pro Center or from us directly. Nobody offers better price, quality or warranty than we do ... so why swerve?

Next time we'll talk about our part in developing the great Sylvania STR 415 type 6 6 and how we're on the verge of seeing something fairly close reappear on the market. Remember, we still have some of these super rugged mondo-bottles available for older amps — **Boogies** only please! Until then, Relax, Breathe and Nourish your soul!

Cheers!

Mesa/Boogie Ltd.

Randall Smith
Designer & President

SPEAKER IMPEDANCE MATCHING & HOOK-UP GUIDE:

IMPEDANCE:

Wiring up speakers to provide the most effective load and making sure that all of them are in phase will help in creating the best sound possible. This is not too difficult, as long as you understand a few things about loading and how to connect your speakers to provide an optimal resistive load.

Mesa Boogie amplifiers can handle 4 and 8 ohms effectively. Never run below 4 ohms in a tube amplifier unless you are absolutely certain that the system can handle it properly; this can cause damage to the Output transformer. A few amplifiers can handle 2 ohms effectively without damaging them (for example the **Mesa's Bass 400+**). You can always have a higher resistance (16 ohms, for example) without damaging results, but too low of a resistance will likely cause problems.

MIS-MATCHING:

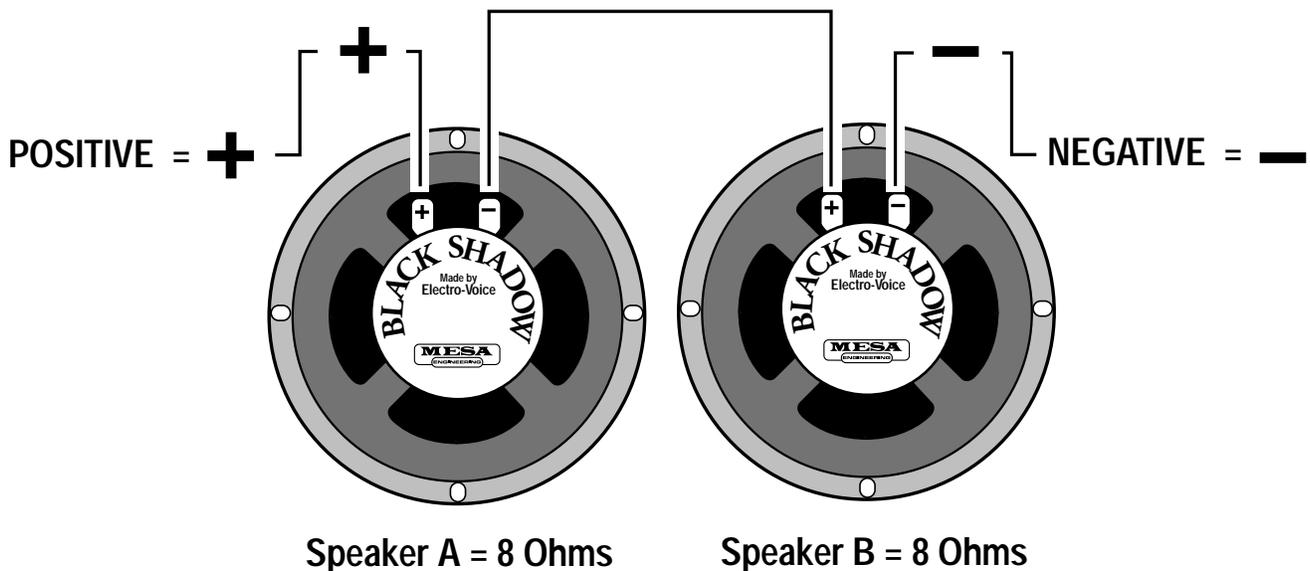
When running a higher resistance (for example: 8 ohm output into 16 ohm cabinet), a slightly different feel and response will be eminent. A slight mismatch can provide a darker smoother tone with a little less output and attack. This response is a result of the amplifier running a bit cooler. Sometimes when using more than one cabinet a mismatch will be the only option.

WHAT IS MY CABINETS IMPEDANCE:

If you have only a single speaker, you just match that single speakers impedance to the amplifier, and you are done. In many cases, you will have a number of speakers, and then you must calculate the "load" that the amplifier will need to support. There are generally three ways to wire multiple speakers together. They are as follows:

SERIES:

When you wire (hook-up) speakers in Series, the speakers resistance (as measured in ohms) is additive - i.e. putting two 8 ohm speakers in Series results in a 16 ohm load.

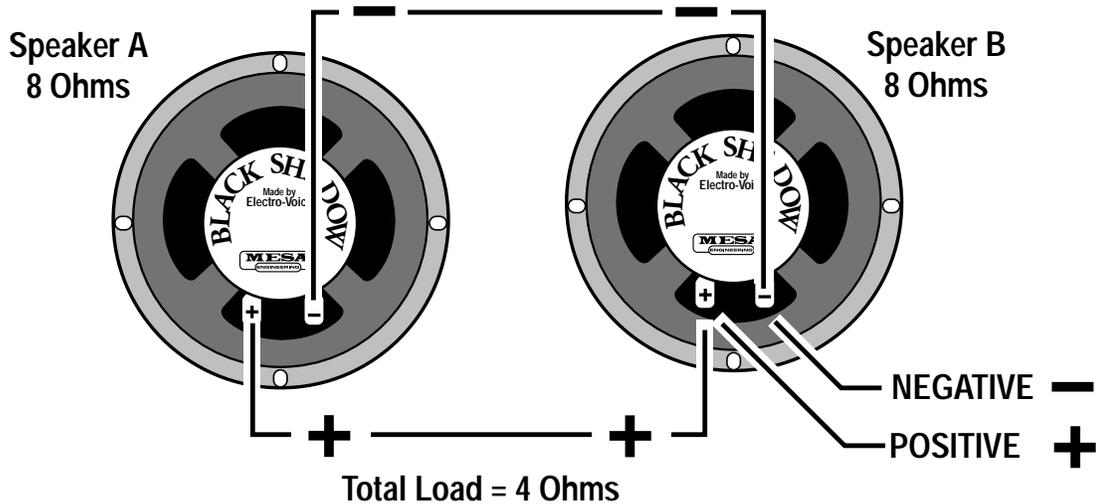


SERIES: Connect the Negative side of Speaker A to the Positive side of Speaker B

SPEAKER IMPEDANCE MATCHING & HOOK-UP GUIDE: (Continued)

PARALLEL:

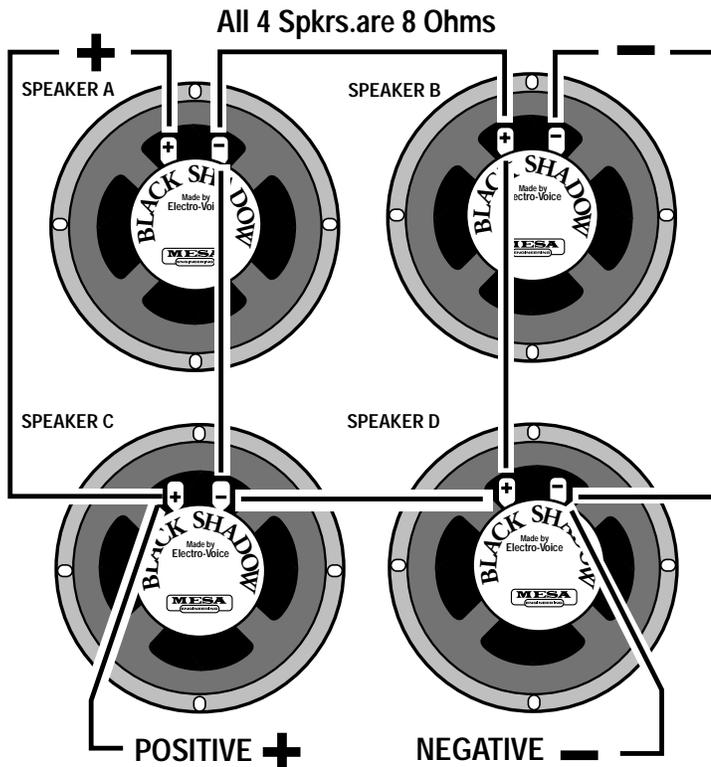
When wiring in parallel, the resistance of the speakers decreases. Two 8 ohm speakers wired in (hooked-up) Parallel results in a 4 ohm load. It's easy to calculate the effect of a resistive load when all the speakers are all the same resistance. It is really not suggested to wire different resistive load values in Parallel (8 and 4, 16 and 8 etc.) The formula for figuring the total impedance in Parallel is the multiplication of the two loads divided by the sum of the two loads - i.e. putting two 8 ohm speakers in Parallel results in a 4 ohm load. Connect the Positive side of Speaker A to the Positive side of Speaker B - Connect the Negative side of Speaker A to the Negative side of Speaker B.



COMBINATION SERIES & PARALLEL:

This is really just two sets of Parallel wired speakers connected in series. This is how you maintain a consistent load with multiple speakers. The importance of this is more evident when you have more than one cabinet to connect to your amplifier.

This is when you need to figure out the loads and how to wire them up without applying too low of a resistance on the amplifier.



Simply connect the Positive side of Speaker A to the Positive side of Speaker C.

Connect the Negative side of Speaker A to the Positive side of Speaker B, then on to the Positive side of Speaker D and finally on to the Negative side of Speaker C.

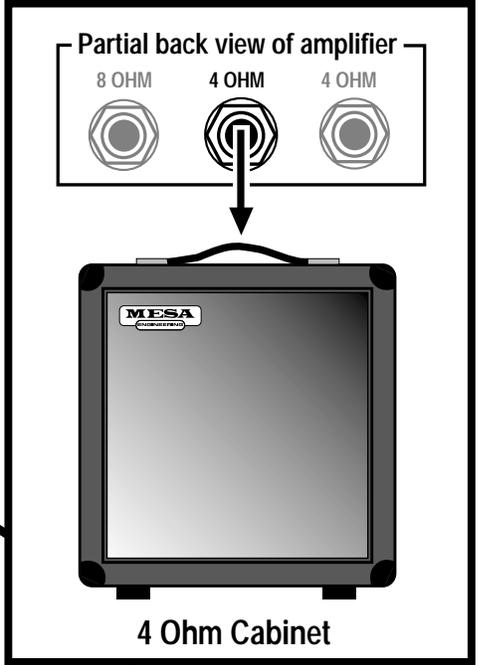
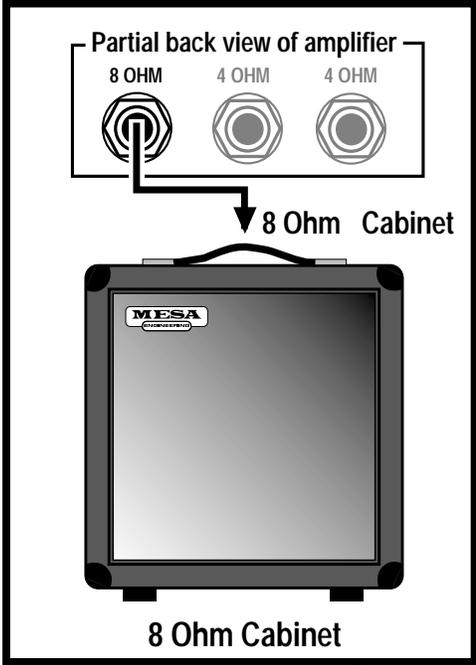
And lastly, connect the Negative side of Speaker B to the Negative side of Speaker D.

4 Eight (8) Ohm speakers wired in Series Parallel = a Total Load of 8 Ohms.

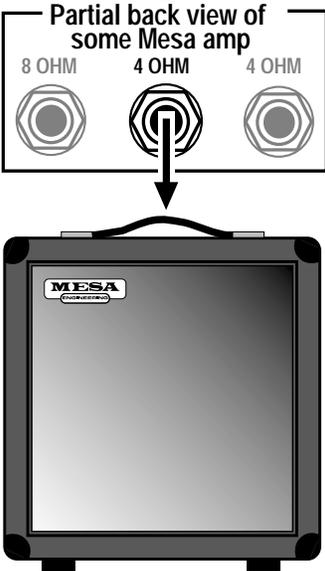
WIRING SCHEMES...Amplifier to Speaker Cabinets

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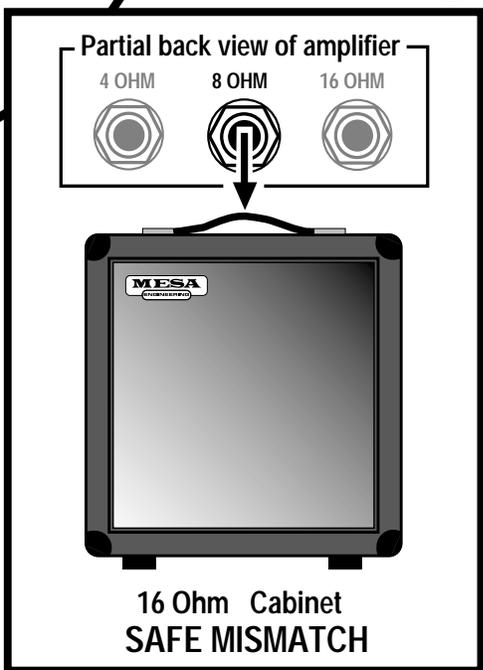
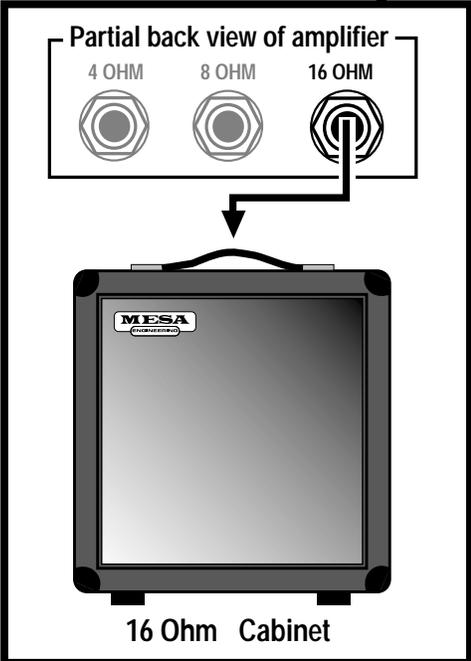


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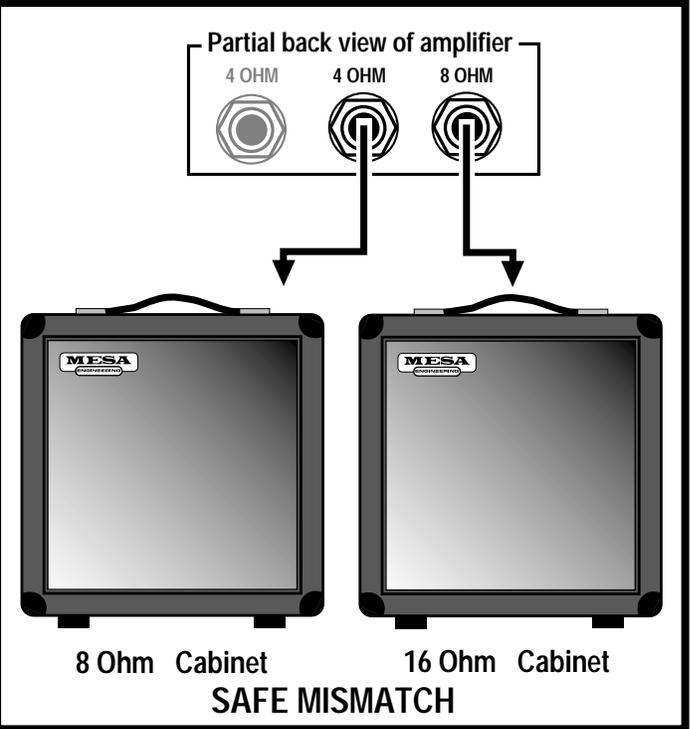
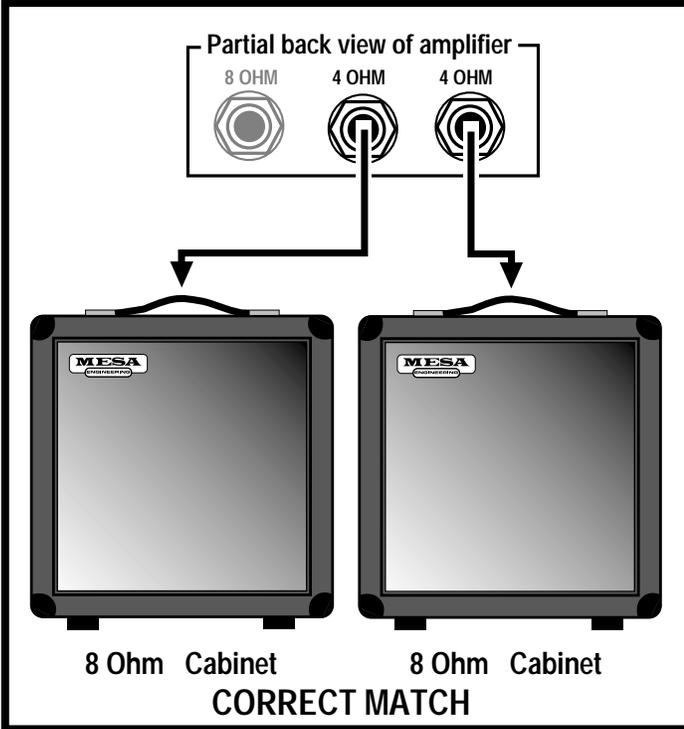
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WIRING SCHEMES...Amplifier to Speaker Cabinets

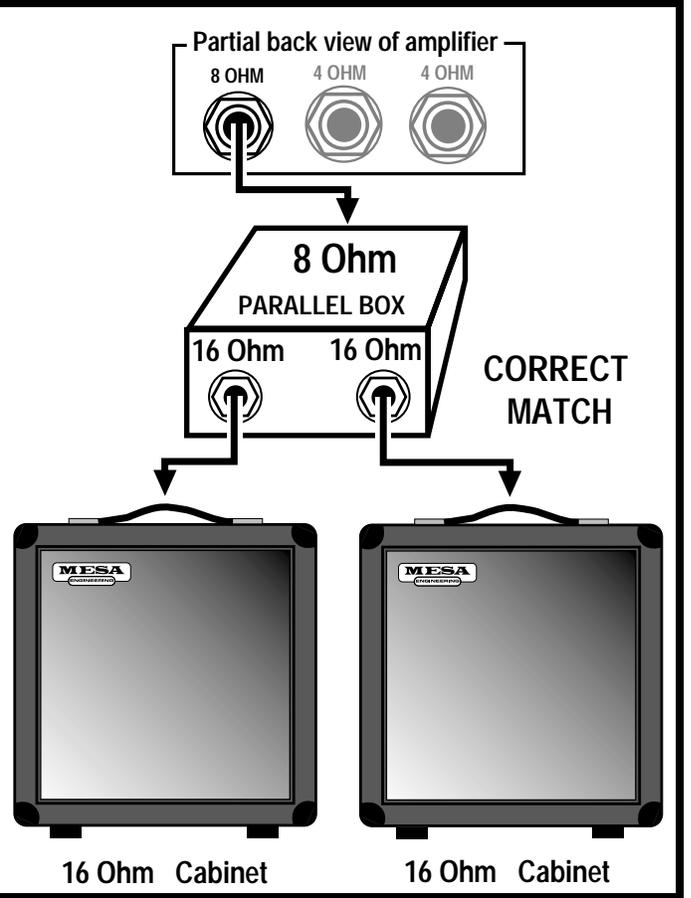
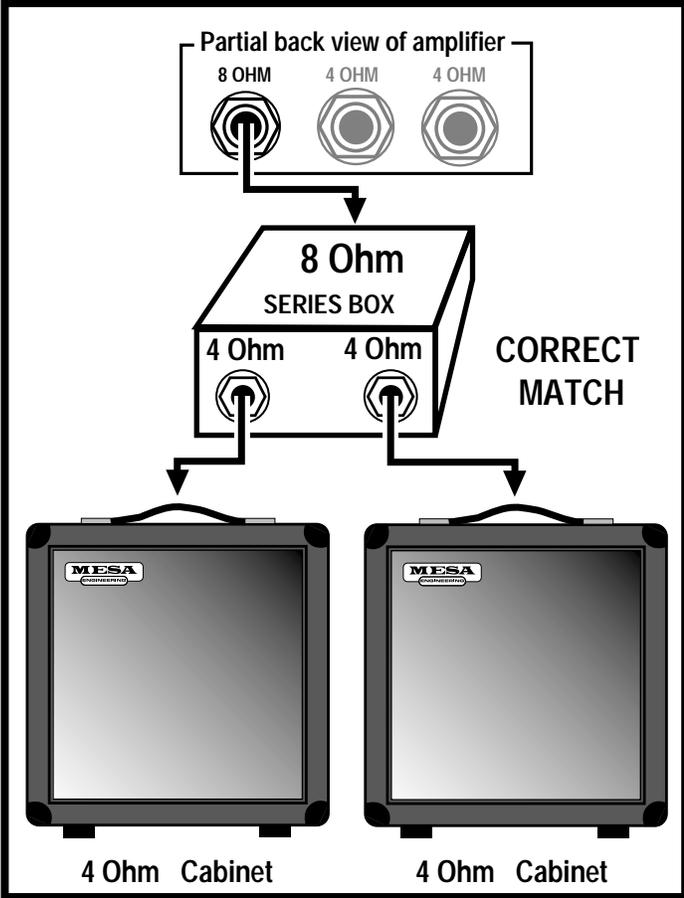
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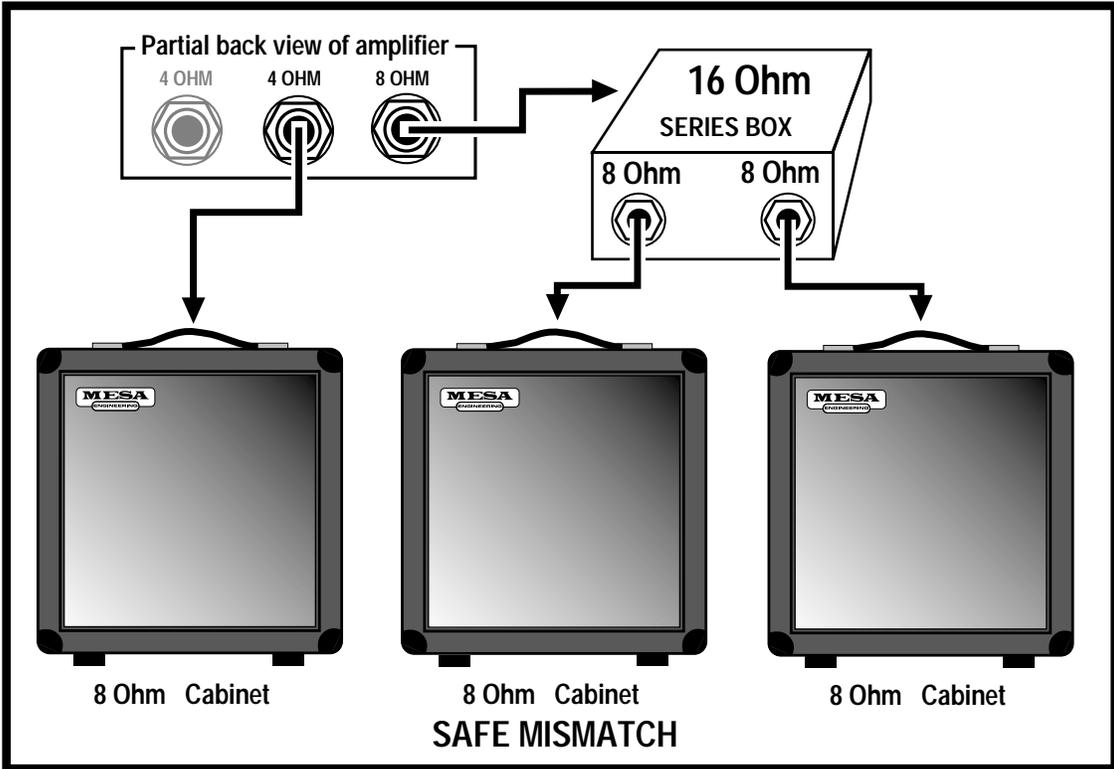
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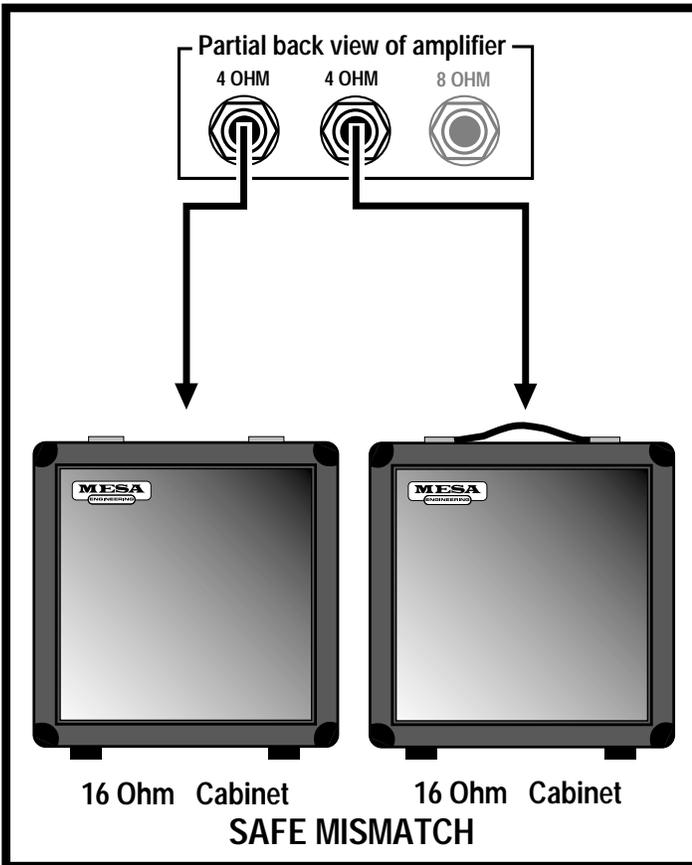


WIRING SCHEMES...Amplifier to Speaker Cabinets

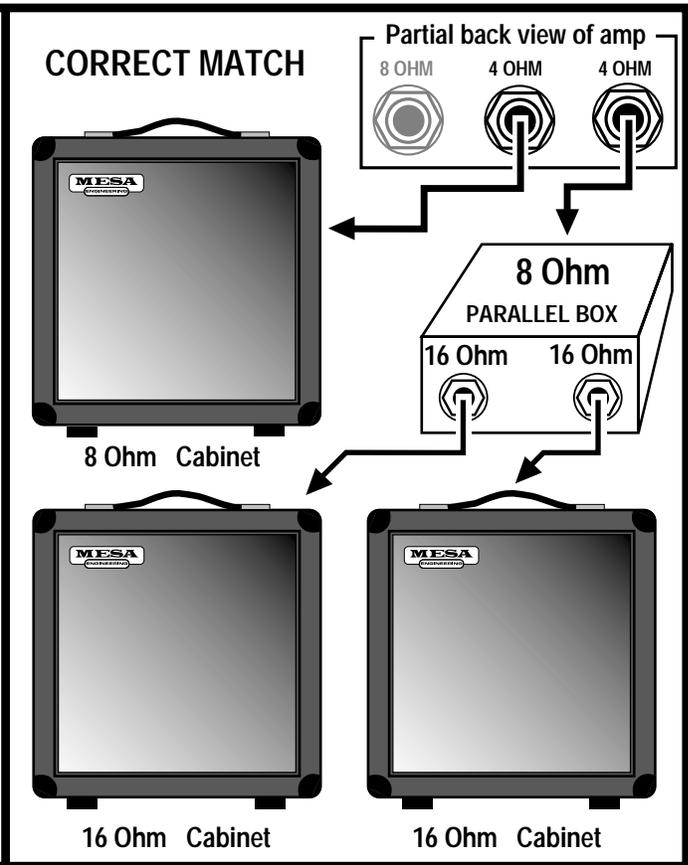
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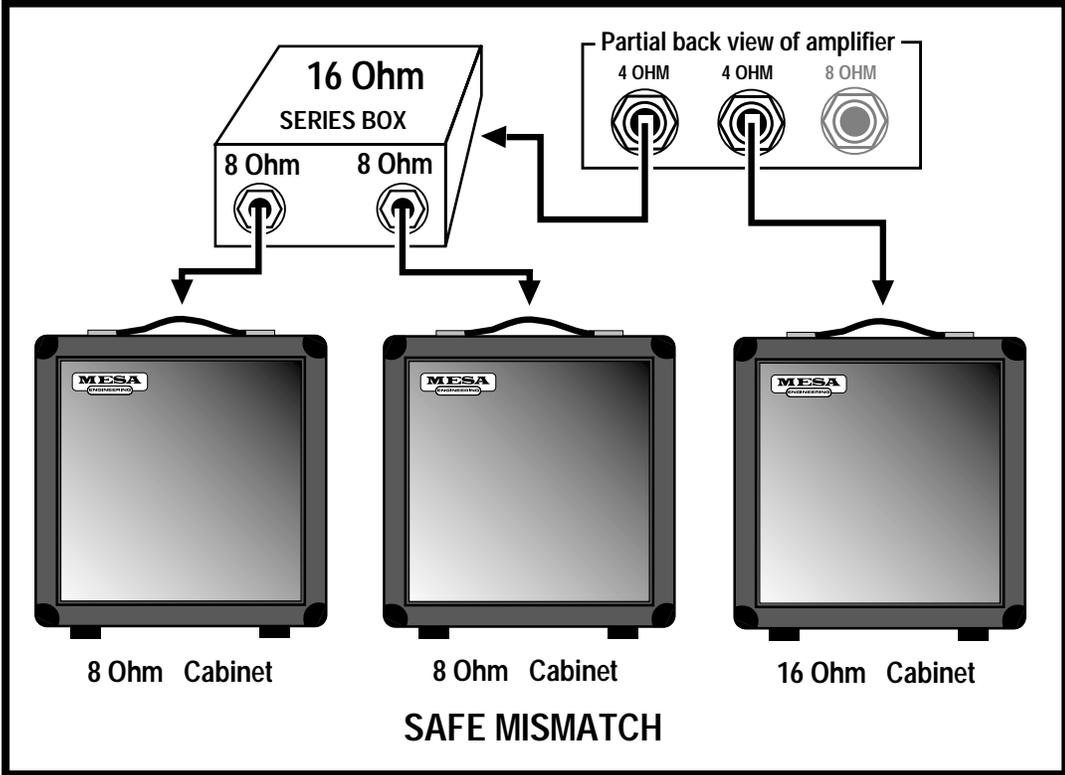


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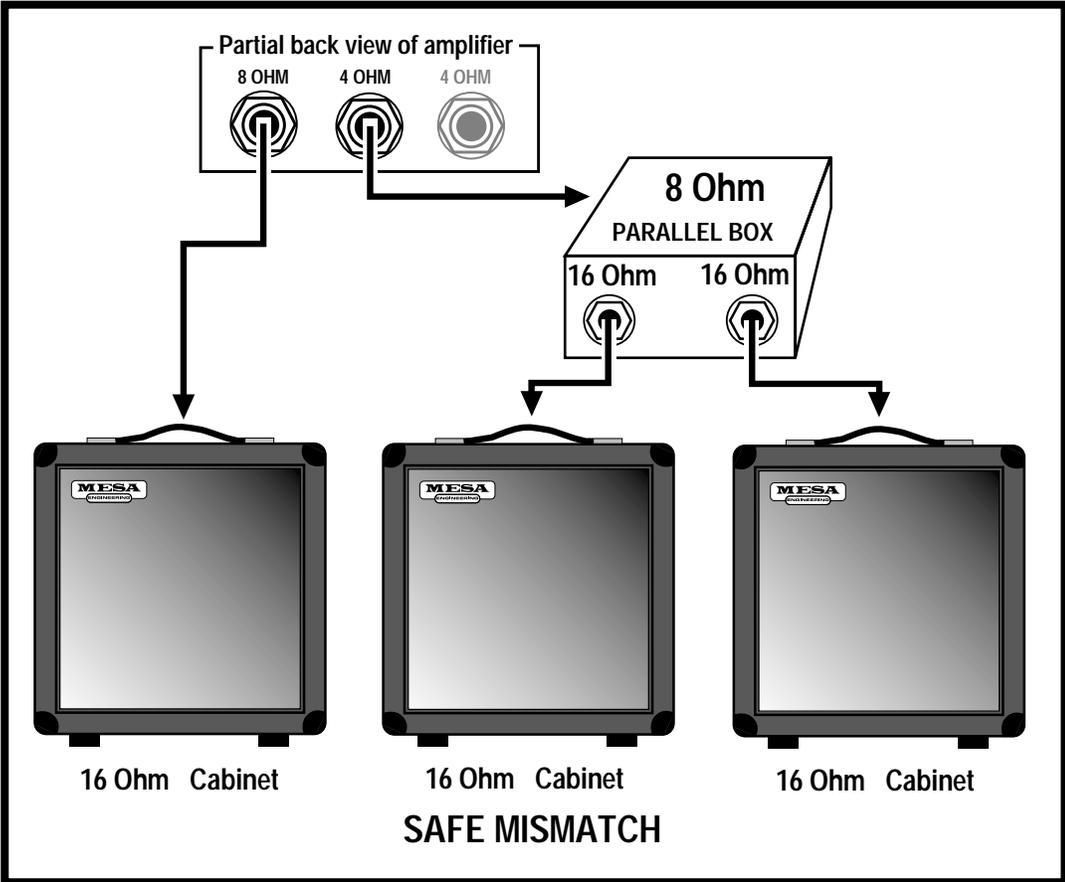


WIRING SCHEMES...Amplifier to Speaker Cabinets

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ON TRIODES, PENTODES & IRISHMEN:

With apologies to Friends and Relatives from the Emerald Isle - who will make their appearance soon enough - the humor which follows is dedicated to the memories of Spec McAuliff and Fae (Rafael) McNally, two of the True Greats.

As their numerical references suggest, the terms Diode, Triode and Pentode indicate the number of elements within the vacuum tube i.e. two, three or five. All tubes also require a filament or heater which is not included in the count. Its purpose is to excite electrons from the cathode coating by raising the temperature such that they are able to boil out of the electron-rich coating material and form a cloud of free electrons in the vacuum space surrounding the cathode.

Although the term filament and heater are often used interchangeably, there are specific differences: A filament is a directly heated cathode where cathode coating is applied directly to the heating element. Examples are 5U4 twin diode rectifier and 300B triode amplifier tubes.

A heater, on the other hand, is a heating element which is separate from the cathode and is usually inserted within the tubular cathode sleeve. Examples are 12AX7 twin triode amplifier and 6V6 or EL84 beam power pentode tubes. In all cases this fundamental aspect of each tube's construction is clearly visible, especially when the heating element is glowing red hot.

The cathode, then, would be considered the first numbered element because it is the source of the electrons. The word itself is from the Greek literally meaning completely down, which implies a sense of central origin - like the center of the earth where Tone begins. It might be said that an ecstatic audiophile experiences a positive catharsis, his soul being purified when his system transports him to Audio Nirvana. The only trouble with taking this positive imagery too far is that the cathode is, unfortunately, negative... at least electrically speaking. However this is easily remembered since virtually all musicians and audiophiles have also experienced the more common negative catharsis when they emerge from the emotional rebirth kicking and screaming in rage and frustration.

Once heated, the intrinsically negative electrons are energetic little fellows of almost no mass. Thus they may be accelerated almost instantaneously and will travel through a vacuum a nearly the speed of light. Being of like, negative charge, they tend to repel one another and thus within the electron cloud surrounding the cathode, there is much jostling and elbowing as each one tries to maintain his distance from all the others... unless there is a strong and universal attraction from an outside influence.

Visualize, if you will, a group of sub-atomic Irishmen milling about and in a repellent, negative state of mind. All are scowling and none wants to have anything to do with the other. Now introduce a strong attraction say, a public bar, and you can easily picture an orderly, if rapid movement of the lot in a single direction. This is what happens when a positively charged element called the anode or plate is introduced into the vacuum.

The plate is the large metal element most prominently visible through the glass of an electron tube. It is the outermost element of a tube's structure and it surrounds all the others. The cathode is at the center radiating electrons outwards. As higher and higher positive voltage is applied to the plate, the attraction for the electrons surrounding the cathode is increased and with nothing standing in the way, full uninhibited flow to the plate occurs...sort of like removing the doors and offering free drinks to the crowd of surly Irishmen milling around outside. As electrons flow to the plate, the space charge will continually be replenished by further 'boiling' of the hot, electron-rich cathode as you can easily imagine other Irishmen impatiently taking up the places of those who've gone inside - until the entire village is deserted.

Now, where do they come from and how do they emerge? Well, a grand and elegant lady once showed me how to revive flat champagne: She dropped a raisin into the glass. There was a dramatic and immediate increase in effervescence with the introduction of a cathoding surface. Thousands of tiny bubbles suddenly appeared - and continued to flow from the raisin. Of course the bubbles were made up of gas dissolved in the beverage, but the analogy makes it easy to visualize the loosely bound electrons dissolved in the rich cathode coating as they effervesce from its heated surface.

But back to the electron flow. If the electrons are strongly attracted to a positively charged plate, then it follows that they are strongly repelled by a negatively charged plate and they are. Thus, if an alternating current - such as comes from a transformer - is applied to

the plate, electrons will flow only during the times when the plate is positively charged. During periods of negative plate charge, ON TRIODES, PENTODES & IRISHMEN: (Continued) electron flow is stopped and the space charge of electrons remains compressed in the area around the cathode.

Thus a diode tube - one with a cathode and an anode - is mostly used to rectify alternating current into direct current by passing it without restriction, but in one direction only. This also explains why closing time is strictly enforced at Irish pubs: During normal operation, the traffic flow is similarly unimpeded and uni-directional toward the bar and this process rectifies the work-day negativity. It goes without saying that no one leaves as long as the atmosphere around the bar remains positively charged.

TRIODES:

This section is a continuing technical treatise on the workings of Irish Pubs but to make it easier for the layman to understand, it is explained in terms of vacuum tube technology. Enter the original bar - free beer and no doors. Well, it turns out that some control over the flow can be a necessary and useful advantage. This led to the invention of those swinging louvered saloon doors which are open at the top and bottom. They are patterned after the control grid of the vacuum tube, which is a loosely wound coil of thin wire located between the cathode and the plate.

In a Triode the plate is always positively charged with high voltage D.C. and even though the grid is blocking the path, those negative electrons can still FEEL the strong attraction - just as the Irishmen can see in through the louvers of the bar doors. They know what pleasures lie beyond, but to get there requires overcoming the negative influences controlling the access. This negative influence is typically called a Bias. In electronic terms that means the grid is supplied with a voltage which is slightly MORE NEGATIVE than the already negative electrons. The more negative the Bias, the more it tends to neutralize the attraction of the plate and repel the electrons back toward the cathode.

The Irish can be similarly charged with Bias, but unless you are Irish yourself, this type of Biasing may be more difficult to understand. The effect is similar though: The more negative the Bias, the more it impedes forward progress. Generally speaking though, the electronic Bias of the grid is easier to overcome, and for two main reasons: First, the Bias is set - like the bar doors - to allow some passage. Second, the grid is mostly NOT THERE, like the louvered doors which are mostly open spaces. Unlike the plate which is solid, the grid is like a coiled bed spring. It can create a repelling field but mostly it's empty space in between widely separated windings of wire. It's very easy to control the electrons as they pass through the grid's force field: Changing the grid voltage only slightly will have an enormous effect on how much current flows through... and that's what AMPLIFICATION is: a small change in voltage at the grid causing a large change in current flowing to the plate.

The purpose of the louvered bar doors is similar to that of the grid, namely, to give momentary pause while still revealing the promise within. Hesitation mostly gives way to temptation, but there are those few stalwart Irishmen who think twice and decide to come back later. Most just pause slightly then go on through. That is the purpose of the bar doors: to prevent everyone from crowding in all at once - and as the door is made less of a barrier, wider spaces between the louvers, more of the bar's attractive influence is felt outside thus amplifying the customer flow and increasing the crowd at the bar.

PENTODES:

Occasionally though, bar doors - even the louvered type - were found to be too effective, and too many customers turned away. Something further was needed to increase the attraction of the bar and overcome the resistance created by the door. Thus the cocktail waitress was invented.

Once again the idea was inspired by the vacuum tube. It had been discovered in some tubes, often large power types, that the distance to the plate was too great to attract enough electrons past the negative influence of the control grid. So another grid coil of fine wire was inserted between the first grid and the plate. This was called the screen grid and carrying a highly positive charge, it functioned as a bait for the plate.

In a properly designed power tube such as an EL84 or a 6V6, the windings of the screen grid are precisely aligned to fall in the shadow of the control grid. This way the electrons responding to the pull of the screen grid are lined up in sheets as they pass between windings of the inner control grid... only to find that they have been fooled! Once past the control grid and drawn toward the screen

grid, they discover...there's almost nothing there. The path they're on has them aligned to zing straight through the spaces BETWEEN ON TRIODES, PENTODES & IRISHMEN: (Continued) screen grid windings. So rather than a close and personal encounter, they just fly on past - and once they're out that far, there's no stopping them. The influence of the plate takes over and - being solid metal and of the highest positive attraction - it is at this final destination that the electrons congregate.

Thus the proper cocktail waitress - visible through the louvers - is scantily clad so as to be all the more effective at reinforcing the attractive influence of her bar and by being located in between the door and the bar, she serves as bait to lure customers past the door's negative influence. Once through the door however, it is the rare Irishman who actually comes in personal contact with the cocktail waitress as, for all intents and purposes, she - like the screen grid - turns out to be a vanishing illusion. Yet, having come this far, the solid influence of the bar itself now takes over and attracts the customers to congregate, having happily reached their destination.

If you're still following this and haven't lost track of the count, you'll know we're still one element short of the five needed to make a Pentode. This last part is a pair of beam-confining shields which being negatively charged, serve to direct the flow right toward the plate. This is much the way a short entrance hall to the bar prevents wandering accidentally into the Men's room on the way.

Once at the bar though, the circuit is complete and the process of soul-nourishing works its ritual magic. Biases having been overcome, illusory nightingales having vanished, the spirits truly soar and the once surly Irishmen now are filled with warmth, wit and kindred friendship, enjoying the music and glowing nicely with their heaters on.

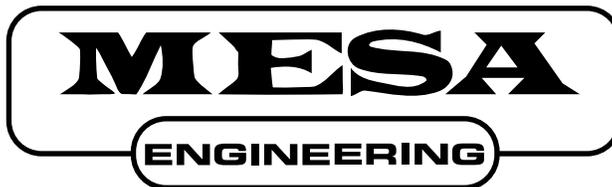
With appreciative thanks to the inhabitants of the Land of the Leprechaun, we have now concluded our little diversion into the mechanics of proper bar lay-out.

A feature article by Randall Smith
Designer / President

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