MESA/BOOGIE

Strategy 400 Stereo
Operating Manual

CONGRATULATIONS AND THANK YOU!

You've just become the proud owner of the world's most musical power amplifier: The Strategy 400™ Stereo. All of our efforts have been directed at making this a special piece of equipment -- a fine hand-made musical instrument -- that we hope you'll enjoy and treasure for many years to come. Your total satisfaction is our highest priority and we appreciate your good word-of-mouth referrals. So when people compliment you on your sound, you can smile knowingly and hopefully you'll tell them a bit about us.

VACUUM TUBE AUDIO

People who don't know about MESA/Boogie are usually surprised when they learn that we make amplifiers using vacuum tubes. They think tubes are some obsolete relic of a primeval electronic age, long ago faded from earth. And that's largely true-- but with two notable exceptions: TV picture tubes and Audio.

Have you ever heard of a tube amp claiming to have "that great transistor sound"'? Neither have we. So here's a clue that many knowledgeable types -- even the latest MOS-FET designers -- hold good tube sound as the standard for comparison. And now, with the introduction of the Strategy 400 Stereo, a new, higher level of musical performance has been made available -- and at a very affordable price when compared to the few fabulously expensive "esoteric" tube.

DESCRIPTION AND FEATURES

The Strategy 400 Stereo is a modern, all-tube power amplifier-hand-built in the musical instrument tradition. Producing 200 watts of mid-band power-- the Strategy excels in playback systems-especially home stereo--and is unequaled for musical instrument performance including guitar, bass, keyboards and electronic drums. In all of these applications the Strategy will deliver state-of-the-art performance and almost certainly sound much better than whatever is presently being used. You will enjoy an outstanding musical richness that is the result of year's of careful design and refinement spanning the range from individual components to overall concept.

INPUT CONNECTORS

Each channel of the Strategy includes a 1/4 inch input jack plus a female 3-pin XLR connector. The XLR is wired as an unbalanced input with pin 2 hot and pins 1 and 3 grounded. An additional 1/4 inch jack offers access to both channels simultaneously and is labeled "Parallel Inputs A+B". Located on the rear deck of the chassis, this is a mono jack with a built-in switch so that a single mono cable will drive both channels of the amplifier. It is vital when using this jack that both channels be connected to separate speaker loads or damage to the output tubes and/or transformers may result. You can listen to each channel individually by using the Standby switches although a slight distortion may occur when using the Parallel Input Jack if one channel is operating and the other channel is standing by. When both channels are ON, this slight distortion will go away entirely.

INPUT CIRCUITRY

The Strategy 400 Stereo offers extremely sensitive input circuitry: 0.2 volts will produce full power when the Level control is turned fully up. This means you can actually plug in many signal sources directly without needing a preamplifier. The output from virtually any effect unit is strong enough -- as is any keyboard, CD player, cassette deck... even electric bass plugged in direct produces full power with incredible tone. Electric guitar needs more tone shaping to sound right but can still be plugged in direct for testing purposes. When using the Strategy with a preamp you should turn down the Level controls for best signal-to-noise performance and easy controllability from the preamp knobs. With the MESA/Boogie Quad preamp, settings from 2 to 5 are recommended for the Strategy Level controls. With the Level set at 7, input sensitivity is reduced to 1 volt for full power out. With the Level at 6, 2 volts are needed; and at 5, 3 volts of signal deliver full power. Input impedance of each channel is 75K ohms which becomes 37.5K when using the Parallel Input jack, still high enough to be perfectly compatible with virtually any signal source.

OUTPUTS

Each channel of the Strategy 400 offers two 8 ohm plus two 4 ohm quarter inch jacks for connection to speaker cabinets. Unlike transistor amps, the 400 will produce full power at either 4 or 8 ohms, and mismatching of speaker impedance will not cause damage or severe loss of power (extreme mismatches will decrease tube life however). Avoid running either channel without a proper load or damage may result. When using more than one speaker cabinet on a single channel, remember that the total impedance goes down as more cabinets are hooked up. For example, if you use one 8 ohm cabinet, use one of the 8 ohm jacks. But if you use two 8 ohm cabinets on the same channel, they will be operating in parallel and the total load will be 4 ohms. Therefore plug each cabinet into a 4 ohm jack.

LED POWER INDICATORS

The output power of each channel of your Strategy 400 is continuously monitored by simple LED indicators. Reflecting the logarithmic relationship of loudness and power, the first LED comes on at 12.5 watts (-12 db); the second at 50 watts (-6 db) and all three at 200 watts. Due to the 400's large dynamic headroom and predominately second-order harmonic distortion, it is quite possible to light up all three LED's very strongly before objectional clipping distortion is heard. A more complete explanation of distortion appears later in this manual.

POWER AND STANDBY SWITCHES

AC Mains power is turned on via the Power switch and indicated by the pilot light. Before switching on the power, place the other two front panel switches in the Standby position. Allow 20 to 30 seconds of warm-up time before switching the Standbys to On. This helps extend tube life by preventing a high-voltage turn-on surge, however, all amplifiers are tested to withstand this extra stress in case you neglect to follow the best procedure.

POWER TUBES

The main power tube used in the Strategy 400 Stereo is the MESA STR 415 type 6L6 GC which provides smooth, warm musical power and is very reliable. The 6L6 we use is extremely rugged and has very low 3rd harmonic output when overdriven. All twelve sockets should be fitted with STR 6L6's when the Strategy is being used in any application other than live guitar. We have specially adapted 4 of the sockets-- those along the rear edge-- to accept either 6L6's or STR 416 type 6CA7/EL34. This tube is characterized by more prominent harmonic output when driven hard which produces a brighter, more grinding high-end, usually preferred for guitar. No internal changes are required; the two type of tubes are immediately interchangeable. Thus one model amplifier with interchangeable tubes replaces the two different types (normal and Simul-Class) described in some of our catalogs.

You can expect 6 month to 2 years -- or more -- of outstanding performance from your MESA power tubes, depending on use. Tube wear is gradual and usually goes unnoticed until new replacements are installed. Worn power tubes tend to sound flat with reduced punch, clarity and high-end. Occasional loss-of-power or sporadic blowing of fuses is nearly always caused by troublesome power tubes. Often, you can spot the tube at fault and replace only it at considerable savings over replacing all the output tubes. A tube that arcs or "flashes over" inside should be replaced immediately (in an emergency, you can just remove the bad tube and go on with the show... "running on five cylinders"). Sometimes tubes will "short-out" intermittently, turning red hot all over the large metal plate inside, but usually a momentary switching Off of the Standby or Power will enable the tube to straighten out its electron flow and return to proper operation. Should this happen repeatedly, careful observation will usually reveal which tube is shorting, even though one or two others may also turn red hot after a few moments. Try to see which one is reddest or turns red first - that is the bad one and the others are most likely unharmed. Internal circuitry is built to withstand tube failures as much as is possible and damage -- though it almost never occurs -- would be minor and easy to repair. When replacing tubes, please use only the MESA types specified. Using others makes will invalidate your amplifier's warranty. To remove tubes, you must first push back the black spring retainers clamped against the tube base. When reinstalling power tubes, check that the spring clamps are making good contact with the tube base and bend them in toward the center before plugging in the tube, if need be. Avoid excessive wiggling of the tubes when removing or installing as it can break off the small plastic key which insures correct orientation of the tube in the socket.

BIAS

As with all MESA amplifiers, the bias is permanently set during construction and never needs adjustment. This saves you any technician's fee for readjustment and prevents the bias from "wandering" or being accidently set improperly.

DRIVER TUBES

The four small tubes are all type 12AX7, also known as 7025, ECC83 or MESA SPAX7. These tubes are very long lasting and trouble free in the Strategy, but best performance will result from using genuine replacements. The input stage of your 400 uses a special "instrumentation grade" differential amplifier with a proprietary constant-current-source diode.

This is a high-tech little solid-state part which enables the phase splitter to work in a simple, self-balancing mode -- one of the keys to great performance. Occasionally a certain 12AX7 will not quite match this device and one channel will sound weak as a result. Merely try another tube, or exchange it with the one next to it. Generally though, our experience with the M-180 and M-190 predecessors of your Strategy 400 means that you should enjoy many years of trouble-free service from your Strategy 400 Stereo. Following is a brief discussion of the differences between tubes and solid-state, however we think the performance of your new Strategy 400 will be the strongest argument of all in favor of great tube amplifiers.

TUBES VS. TRANSISTORS

Much has been written on this topic... It's an interesting one and will never be fully decided one way of the other. Because of the great economic advantage of solid-state, audio has proliferated beyond any prediction that could have been made a mere 25 years ago. Cassette decks, ghetto-blasters, home recording, pocket radios -- all these would be too big and expensive to build in mass quantities with tubes. Yet most musicians agree that tube amplifiers (and many of you have purchased your Strategy just for use in your own rack, where it's totally state-of-the-art). Less well known - but equally convincing - is how well the Strat delivers for bass, keyboard or stereo playback. You've got to hear it to believe it; then the arguments for the economic benefit of solid-state can be judged against the better sonic performance of tubes.

The basic characteristic of a transistor is that it operates much like a simple switch -- going either full-on or full-off. That's why they're so good in computers and other digital applications. A tube, on the other hand, is basically an analog device: It's "full-on and full-off" switching operations are a bit hazy and strained because it would rather work the in-between area of "partially-on", tracking a "now-more, now-less" type signal. Think of a tube behaving like its British name: a valve, regulating a flow of current that is dynamic and pulsing. Then think of the physical action of live music: it's a series of pressure changes in the air which act on the ear drum in the manner of a pulsing and dynamic flow (analog behavior) as opposed to a digital sequence of "full-pressure-or-no-pressure". So the basic nature of a tube's operation makes it the more natural choice for musical amplification. Yet solid-state amplifiers usually outperform their tube counterparts when it comes to producing great specs in the laboratory. Here's an explanation of why this is and why it doesn't matter.

DISTORTION AND NEGATIVE FEEDBACK

Negative Feedback is a correcting process used in virtually all amplifiers to "erase" distortion. It works by taking a portion of the output signal (traditionally right from the speaker jack) and re-inserting it into the input -- but out-of-phase with the original signal. By definition, anything extra produced by the amplifier is distortion. So by inverting a portion of the output signal and running it back through the amp "upside down", the distortion products

tend to cancel themselves out and disappear (the original signal is also reduced so extra "gain" is designed in to more or less compensate). How much NFB is the "right amount"? It depends on the the amplifier. A "perfect" amplifier would have no need for negative feedback... and in-fact your Strategy 400 uses about one-fourth as much as the previous best tube designs.

Transistor amps by contrast, use hundreds of times more NFB in order to force themselves to behave well and iron out their natural tendency to work abruptly -- like a switch.

TIME LAG AND TEST SPECS

Large doses of negative feedback certainly work better in the lab than they do in "real time" because virtually every amplifier has some degree of time-lag in getting the signal through to the output jack. An amp that needs heavy negative feedback has trouble with music because the time delay causes the corrective remedy to always lag behind the music. Distortion must literally begin to appear before it can be fed back to perform its therapy. And by then the attack of the note has already begun! And since music is complex and constantly changing, a lot of what you hear can be the amp trying to "clean up its act". This is called "transient intermodulation distortion" - TIM - and wasn't even discovered until well into the transistor era... because it was never known to occur before with tubes and their much lower dependency on corrective negative feedback. But when TIM was finally discovered, it went a long way toward explaining why the "low distortion" transistor amplifiers sounded harsh and distorted when compared to tube units. TIM was truly egg-in-the-face for some heavy designers who proclaimed that the harshness of their designs was actually the absence of distortion (their numbers backed them up) and that people would just have to get used to hearing the new sound of "truly pure, undistorted music!" Solid-state has come a long way since then. Now there are some "audiophile quality" designs available - but at three to ten times the cost of your Strategy 400, and to our ears, still not as good sounding.

All this specification controversy occurs because music itself is far too complex and fleeting for measurement of distortion under actual "real time" conditions. So a simple, steady tone is used for laboratory testing and that gives negative feedback plenty of time to act before distortion test numbers can be generated.

The distortion of your Strategy 400 remains well below the audible threshold up to -- and even beyond clip -- because some types of distortion are far less noticeable than others. And this brings us to the other major difference between solid-state and tube amplifiers. You've probably heard such things as "tube amps clip soft, transistor amps clip hard" or "even-order distortion vs odd order"... So here is a simple explanation of what happens when an amp clips and what kinds of harmonic distortion result.

HARMONIC DISTORTION

Think of an amplifier as a big lever where you're pushing up and down on the short end, close to the fulcrum. A small amount of motion on your end produces a much larger swing on the other end. But there's always going to be some point where the large end runs out of swinging room - for example: you've hit the ceiling. This corresponds to the amplifier's running out of power -- or headroom as its aptly called. The result is called clipping distortion because the tops and bottoms of the swing are limited and "clipped" off because they should have gone further if responding faithfully to the action of the short end. So as long as the

swinging is confined to the region between the floor and ceiling -- isn't hitting either one -- the lever (amplifier) is operating in its "linear region". This simply means that there is a constant ratio to the leverage: push the small end up and down two feet and the big end moves six feet; swing the short end three feet and the long end moves nine feet. So in this example the ratio (also called amplification factor or gain) is three. And if we're swinging this lever in a room that's ten feet high, we want to maximize our swinging room (headroom) in both directions by locating the fulcrum half way between the floor and the ceiling. Engineers would call this "operating around the mid-point of the linear region". But what if we want to push the short end up and down four feet and the room is still only ten feet high? obviously the big end is going to slam into the ceiling because it can't move any farther. And it's going to stay there for a moment before it begins to swing down toward the floor. Then again, it's going to crash into the floor and stay there for the period of time it would have taken to go one foot further down and back before it starts rising again. This is what happens when an amplifier runs out of power. And clipping distortion occurs because the extra swing dictated b the "overdriven" movement of the short end cannot be achieved by the big end and the "linear ratio" breaks down. In an amplifier, the onset of clip is the point where the distortion increases radically by generating various added harmonics -- or overtones-that weren't present in the original signal.

Now let's carry this analogy a little further and we can contrast the way clipping occurs in tube and solid state amplifiers. Picture this same ten foot high room now with a padded rubber floor and ceiling. The action of the lever's long end slamming into the elastic rubber is that it gradually comes to rest before pulling away -- not suddenly as though hitting concrete.

True, the simple linear ratio of motion no longer holds (and so there is distortion) because a four inch motion applied to the short end won't result in the proper 12 inch motion once the long end has contacted the rubber ceiling but it will move at least a few inches against the increasing resilience of the spongy rubber. And this is akin to the soft, compression action of a good tube amp when it clips, while the example of the concrete ceiling and floor fairly well represents a typical solid state amp running out of headroom. The motion ratio remains perfectly constant right up to the onset of clip where its travel is abruptly stopped and restarted again. It's this softness -- or abruptness -- that determines which harmonics are generated when the amplifier clips. And you know from your own experience with plucking a string how much the harmonics are determined by the way you set the string in motion. If the string is accelerated abruptly -- like plucking it with a dime -- you get strong upper harmonics, even if you pluck softly. But if you use something soft like the flesh of your thumb to set the string vibrating, there are almost no upper harmonics -- no matter how hard you thumb it.

LOW ORDER DISTORTION

As you probably know, harmonics (also called overtones) are what make up the timbre of each instrument so that the A440 of a clarinet sounds different from the A440 of a saxophone. The sax tone is rich in harmonics while the clarinet sound is almost pure fundamental without overtones. Certain harmonics occur naturally in music -- both in the overtones of timbre and as component notes in the harmony of chords. These overtones are often called the "low order" or "even order" harmonics such as the 2nd, 3rd and 4th. These overtones relate to the fundamental note by being one octave above (double the frequency); an octave and a fifth above (called the "quint" in pipe organs, an octave and a half above) and two octaves above for the 4th.

The ear has a great tolerance for these overtones - because they relate in a musically consonant way and are are already present in the original signal, as either timbre overtones, upper harmony or both. For example, it is often possible to add up to 20% second harmonic to a single note before any change is audible. Then all that happens is that the ear hears the timbre change.. it does not hear "distortion trash." If you're a guitar player or keyboardist try this simple experiment. Play two notes, play the low one loudly and the high one very soft at first, then increasingly loud, an octave apart at the same time. Notice how loudly you can play the upper octave note before you can even hear it... and that what you do eventually hear sounds mainly like a timbre change in the lower note -- not two separate notes. Now try playing the same original note but this time also play a note two octaves plus one step above. No matter how softly you play this note, it is distinctly audible and separate from the original.

What we've done with this experiment is demonstrate the effects of different harmonics in contrasting distortion types. You've heard how inoffensive the low order (sometimes called "even order") harmonics can be... especially compared to the prominence of the upper order (often called "odd order"). And as you might guess by now, tube amp distortion is primarily low order while that of most transistor units is odd-higher order... and hence very objectionable. Clearly then, a tube power amp with a higher percentage of Total Harmonic Distortion actually can sound cleaner and clearer and much less harsh than a solid state amp which carries a lower total distortion rating. It's not the total distortion that counts as much as the distribution of distortion components: It's all but impossible to hear even a few percent of 2nd harmonic distortion whereas a fraction of "high order" type becomes audible as annoying hash.

When playing very loudly, you may notice all the LED power indicators are lit up on your Strategy 400 - and yet we seriously doubt that you'll hear distortion - even though clipping begins when the 0 db LED lights up. Two things are happening here: First, special care has been devoted to avoiding high-order overtones and containing the Strategy's clipping distortion to primarily 2nd harmonic. And second: The Strategy has high dynamic headroom and can produce substantial extra undistorted power for short (but musically significant) periods of time. Musical peaks - such as the attack of certain notes - are so highly dynamic that they demand 20 to 50 times the average power produced by the amplifier to come through unclipped. So good sound requires more than just plenty of brute power. It demands good performance after ratings have been exceeded as well as before because some clipping is almost unavoidable.

CONCLUSION

This discussion has concentrated on the extreme end of power performance because that's where the differences between amplifier types are most noticeable. And, we expect, extreme power performance is one big reason for your interest in the Strategy 400. Rest assured that all those factors that enhance high performance are also benefits at other times. Thanks for reading this far, we hope this explanation has bettered your understanding for the science -- and magic -- of great sound. Most of all, enjoy your music and enjoy your Strategy 400 Stereo.