Vol. I No. 5

NEW G.A.S. CO. 20,000-SQ. FT. PRODUCTION FACILITIES.

INTRODUCING THOEBE AND GOLIATH

In the opinion of many experts, Ampzilla has firmly established itself as one of the classic power amplifier designs of this era. Thaedra has convinced the industry that a solid-state preamplifier can now not only challenge, but outperform the best vacuum-tube designs. Great American Sound Company's Son of Ampzilla delivers a state-of-the-art power amplifier at affordable prices.

Realizing these achievements in less than 1½ years, Great American Sound Company now announces their latest products, the Thoebe servo-loop preamplifier and its companion pre-preamplifier, Goliath. Thoebe shares with Thaedra identical servo-loop electronic circuitry and sonic performance, but at a much lower cost. With the addition of its companion pre-preamplifier Goliath, Thoebe achieves Thaedra's unique capability to accommodate all moving-coil phono cartridges.

Thoebe is ideally suited for use with the Son of Ampzilla power amplifier and has been designed with a matching front panel for this purpose.

Matched to Thoebe's styling, Goliath is an auxiliary pre-preamplifier, a mere 2¼-in. wide to be used specifically with Thoebe to provide the additional gain and low-noise performance necessary to accommodate a moving-coil phono cartridge. A power jack on Thoebe supplies Goliath's power requirements.

THOEBE

All-complementary circuitry from input to output.

Tone controls are 21-position switch type, providing accurately reproduced, readily resettable curves without the possibility of slider-contact noise which is possible with conventional variable potentiometers.

Level control is 22-position switch type providing ± 1 dB match between channels not possible with conventional variable potentiometer.

Main output drive capability for low impedance headphones.

Features same Servo-controlled electronics as featured in Thaedra.

Tape monitoring and tape copy switching for two tape machines including front and rear duplicate jacks for one.

Four selection low frequency filter — 10 Hz, 20 Hz, 30 Hz, or off.

Muting switch reduces output level 15 dB.

Reed relay for turn on/off delay.

Two regulated power supplies, power transformer potted in drawn steel can, double shielded with high permeability nickel alloy.

Provisions to accommodate Goliath pre-preamp for use with moving-coil phono cartridges.

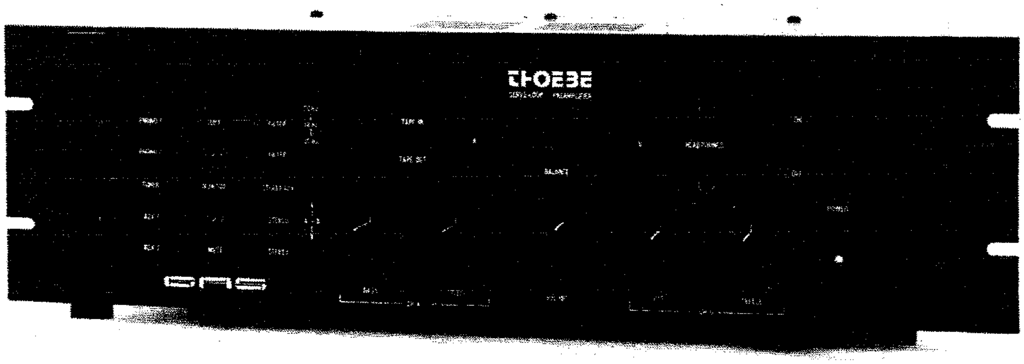
GOLIATH

Servo-controlled preamplifier circuitry is identical to that featured in Thaedra's head amp.

Five-position selection of gain with 3 dB steps accommodates the lowest through highest-sensitivity phono cartridges.

Steel-enclosed construction guarantees freedom from extraneous electromagnetic and electrostatic field interference.

Panel styling matched to Thoebe.



PRINTED IN U.S.A.

KIT REPORT

A CONSTRUCTION REPORT
THE TAMING OF AMPZILLA

by Walt Jung
with the cooperation of
Charlie Schnepf

I WAS ONE of the very first to purchase the Great American Sound Company's much-heralded first product, the super power amplifier kit modestly known as "Ampzilla."[1] Designed by Jim Bongiorno and incorporating many design innovations, Ampzilla appears to be a real value in terms of clean watts per dollar invested, particularly in kit form. However, the successful and painless completion of a kit of this sophistication and complexity is not something which is automatically ensured, nor something which can be covered by the spec sheet. Thus there is a real need for an evaluation report which does more than extol the virtues of a finished kit product.

The sample I tested may well be the greatest ever in many regards; but, more important to the kit builder, can it be duplicated, starting from a box of parts? As a matter of fact, the realization of the performance quoted for any kit is highly dependent upon the person constructing it; and a great deal of the measure of the overall quality of a given kit is contained in how well the manufacturer recognizes potential problem areas for the home constructor, and how effectively he deals with them to guarantee your successful completion of his design.

Kits differ in degrees of complexity, ranging from the simplest up to color TV's, ham radio rigs and super power amplifiers. None of the three latter kits is for the novice; but on the other hand, any potential constructor of a kit on this level should understand his or her responsibility towards success. Thus it is the purpose of this review to illustrate the following:

1. what it takes to complete a kit (such as Ampzilla in this case);
2. the performance of the finished kit.

The emphasis will be on the construction phase, with a blow-by-blow description of difficulties encountered and solutions to problems--the kind of thing you want to know before you decide to put your cash on the line.

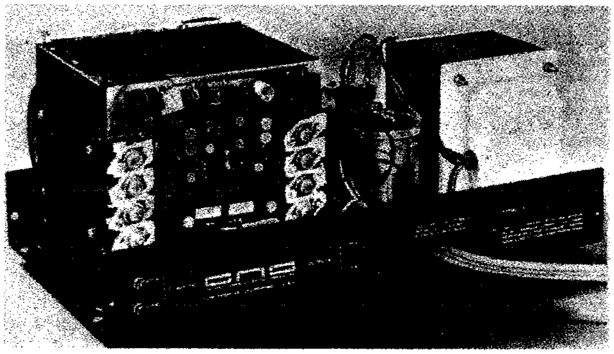


Fig. 1: Ampzilla with the cover removed, rear view.

Ampzilla: A Brief Description

Ampzilla is a super power amplifier, harnessing the capability to deliver 200 watts into 8 Ohms, or over 300 watts into 4 Ohms. This is a per channel rating and it applies on a continuous basis, with both channels driven. THD and IM at any power level (up to full output) is quoted as below 0.05% for 8 or 16 Ohm loads, below 0.25% for 4 Ohm loads. Full power response is rated at ±1dB, 1Hz to 100kHz, while low level (1 watt) response is ±3dB, 0.02Hz to 500kHz. How all of this comes out in the final kit is covered in the "Performance" section below.

Both the mechanical and the electrical design of Ampzilla are innovative; some of the former may be seen in Fig.1, a view of the completed amplifier with the exterior cover removed. Half the interior of the chassis is taken up by the 1.5kw power transformer and power supply components, which supply ±65V* (unregulated) at over 12 amps. You've probably heard of brute force power supplies, but practically everything in Ampzilla is brute force: power switch, line cord, 16,800μF filters, 25A bridge, and a heat sink assembly the like of which you've never seen before.

In fact the heat sink chimney is probably the most distinguishing mechanical (and one of the electrical) features of Ampzilla. This assembly occupies the remainder of the chassis space, and the amplifier circuits are literally built around it. Each channel uses four 16A, 140V-rated TO-3 power transistors which rest at the bottom of the heat sink on either side, facing inward. On the outside, electrical connections are made to these transistors via a small PC board which also sockets an IC bias regulator. This IC is ceramic packaged for thermal conductivity, and rests directly on the main heat sink between the pairs of output transistors. The thermal feedback this provides is used to adjust the bias to the output stage automatically so as to maintain optimum performance in the crossover region. A fan mounted underneath forces cooling air through this 1000 sq. in. heat sink; the warmed air exits through an opening in the outside cover.

*See notes under "Performance," below.

The two large drive boards (one per channel) mount vertically on either side of the heat sink assembly; these mount the largest number of the circuit parts. Eight TO-66 power transistors mount on L brackets which attach the drive board to the main heat sink, as well as heat sink the transistors.

The "integral" design of the drive/output stage/heat sink assembly holds interconnecting wiring within Ampzilla to a minimum; precut lengths and pre-attached, heavy, quick-disconnect connections simplify the assembly of what wiring does exist. Mechanical interconnections (there are loads of screws) are simplified by captive nuts pressed into the chassis--there are no nuts and bolts.

Electrically speaking, Ampzilla is noteworthy beyond the impressive size of its components. Each channel uses a complement of 19 transistors, and is completely symmetrical--push pull from input to output. One feature of this concept of design is Jim Bongiorno's dual differential input stage, which aims at reducing asymmetrically produced distortion (I'll comment later on the performance of this circuit).

The IC regulator I mentioned above programs the bias voltage applied to the output stage. This IC tracks the current in the output stage, preventing thermal runaway, or crossover notches due to insufficient bias. Working in conjunction with the bias regulator is a scheme which maintains a small class A idle current at all portions of the cycle in the output transistors. At low levels the output transistors operate class A, but they switch to class B for high levels, the switching being accomplished via Schottky power diodes. It is this biasing feature which gives Ampzilla its very low low-level distortion.

All internal bias currents within the amplifier are derived from a "floating" regulator, which has a built-in turn-on and turn-off delay. This gives controlled on-off characteristic, which eliminates the ugly thump of switching transients.

Protection is an important factor in an amplifier of this power capability, both for the amplifier and for the speakers it is to drive. In addition to the line fuse, Ampzilla has individual fuses in the ±65V supply lines and fuses in the speaker lines. Also in the speaker lines are thermal cutouts, attached to the heat sink assembly. Within the circuit itself, safe area limiting protects the output transistors.

Building the Kit

Since the kit I received was an early model and probably doesn't represent current production in all details, constructors today would most likely not encounter some of my initial problems. A few parts turned up missing, but were replaced subsequently. The manual provided for the kit consisted of a series of typed instructions which in some cases did not exactly match the parts provided. I received only one wiring diagram, no schematic at all, and no pictorial diagrams. Construction of the kit was therefore laborious, as I had to go back and forth between the typed instructions and the magazine article which supposedly tells you how to put it together.[1]

Neither set of instructions is adequate by itself; but between the two of them I was able to manage. I trust that the final manual eliminates these difficulties, but I have never received one to verify this. However, since the major source of difficulty in taming Ampzilla is not really related to the quality of instruction, the manual is not an overriding factor in this case.

Construction begins with the separation and counting of parts. Although this is the most wearisome phase of any kit to me, it is important. Spot possible missing or damaged parts
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mend setting this voltage at 30mV, which yields 75mA of idle current in the output. This condition yielded the IM results above. You will not go wrong with this quite simple, yet positive method of adjustment, if you have a meter with resolution adequate to make the measurement. You should do it after zeroing output (within a few millivolts) for best accuracy.

Frequency response checks on Ampzilla are also quite a challenge to measure, because of the extremely wide bandwidth. With some difficulty, however, the specs were verified. You will gain an even greater appreciation of the implications of the tremendous power bandwidth of Ampzilla by examining the waveform photos in Fig.4a-d.

I measured Ampzilla's gain and found it to be 27.3dB. This indicates a 1.73 volt RMS input sensitivity for rated output.

1kHz power output at the clipping level was checked and found to be 210 watts into 8 Ohms, both chan- ±75V, a factor which suggests that perhaps my power transformer was an early model which was later updated.

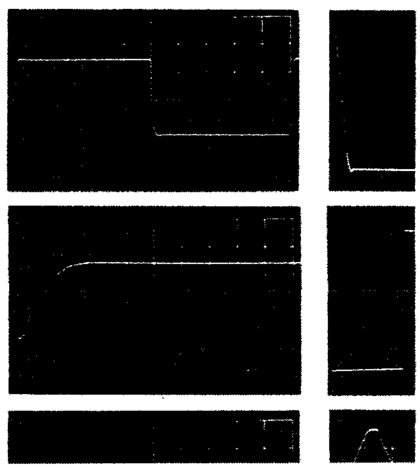
This would explain reports that other Ampzillas cranked out more power (230-250 watts on two other samples whose data was available for comparison). It would also explain some of the sharp rise in distortion just at the 200 watt level in IM tests, just below, but not actually into clipping. At high output currents and output voltage swings which approach clipping, the output stage begins to develop significant IM. This shows up mostly at 4 Ohms, but is also evident in 8 Ohm operation near clipping. At 16 Ohms the effect has almost disappeared, as IM is still only 0.007% at 100 watts of output.

If the higher voltage (75V) supplies are typical of later Ampzilla production, this would mean that high level IM distortion should be even better than the results shown here.

I checked single channel 4 Ohm power amplifier) is fed adequate amounts of AC input voltage. This means *you* must guarantee a full 120V AC at Ampzilla's line cord when it is fully loaded and driven to rated output. Under these conditions, it may well be drawing *over 1kW* from the AC line.

Never use extension cords with a super power amp, and don't connect into circuits which have other loads. Never switch on-off remotely through a preamp power switch, unless it uses relays or other means of handling 10A or more of AC. If possible, run a separate feeder back to your AC power distribution panel, using #10 conductors if you can. This is really a subject in itself, and I hope a future article can deal with the formidable power and signal handling problems in a large modern audio system.

Finally, we get to waveform pictures which say as much about the performance of Ampzilla in themselves as piles of data. These are shown as Fig.4a through 4f.



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construct the heat sink. This is an extremely messy and tedious job, and you end up with heat sink grease all over everything.

Next you assemble the drive boards to the heat sinks, and connect them to the output stage drive board and transistors. After some wiring of outputs, inputs, and power connections, you are almost ready for turn-on.

Double-check everything, run a final Ohmmeter test, and the moment of truth is before you. Rotate the bias trimmer full off to prevent full output stage conduction.

When you first apply power to the full amplifier, it is best to use a Variac or other means of bringing the voltage up slowly. If you haven't a Variac, you can place two 1K 2W resistors in the fuse holder (in series with the ±65V lines). This will reduce the voltage to the circuit; it will still work if it's o.k., but won't blow if it's not.

Setting It Up

GAS recommend you set up Ampzilla in one of two ways. Using a sine wave source, and a 'scope connected to the "distortion out" jack of an analyzer set to null, you bring the output stage bias up to just remove the spikes caused by crossover notches. This works o.k., and you get a positive indication. Alternately, you can set bias on the output transistors to 2.1V with a DC meter.

I found the reading to *be* 2.1V when the distortion was nulled, so this method also works well if your meter is accurate. A caution here: be sure your meter *is* accurate--if it reads low you'll cook the output stage with too much bias current. For this reason I wouldn't recommend this bias setup method be used at all. A sure-fire simple method is detailed below under "Performance."

At this point, with both channels trimmed, the amplifier is ready for use after the heat sink is bolted into place and the remaining mechanical parts are buttoned up.

Performance

Testing Ampzilla proved to be quite a challenge, in more than a few ways. The first go at it brought about the spectacular demise of that set of power transistors. However, even after I had cleared up the problems which caused this, there remained the not inconsiderable task of characterizing its performance with reasonable accuracy. In view of its very impressive specifications and extremely high power, this presents problems in measuring equipment resolution, the AC power source used, and the load resistors used to dissipate its healthy output. All of these factors came to bear in performance testing, but I managed to cope with them successfully. In the narrative which follows, I will mention where I made certain allowances for the sake of finishing this report in a reasonable length of time.

The tests I performed on Ampzilla were the traditional THD and IM tests, frequency response, gain, power output, and a number of waveform photos which illustrate several aspects of performance. Most of the data obtained in these tests is implicit in the figures which follow, but they will also be described so that you can gain an overall perspective for yourself.

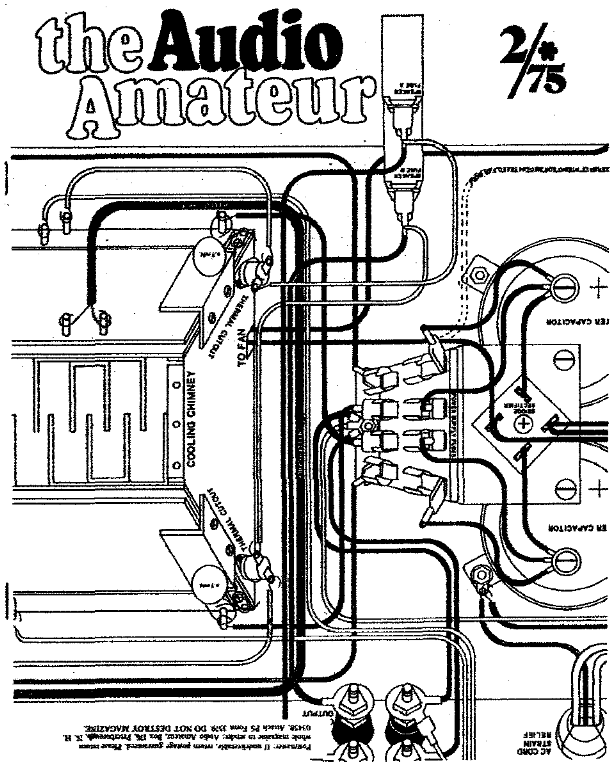
The first test run was for total harmonic distortion across the band at various power levels, with both channels driven simultaneously. This data is shown in Figs.2A, 2B and 2C for 8 Ohm loads. The tests were run after preconditioning for one hour at a 65 watt output. Ampzilla survived this test o.k., but did manage to warm its heat sink chimney quite noticeably.

In general this data is quite good, as it is well below the spec of 0.05% at all but the extreme high frequencies of 15kHz or more.

In fact, at mid-frequency, the THD for levels below 100 watts approaches the equipment residual, which is down around 0.002%. This may be noted from 2C, which is the same data, but plotted in terms of 1kHz THD versus power.

I had a problem with obtaining stable readings below 200Hz due to beat frequencies developed between the test signal and the power line harmonics. For this reason I omit this data, although it never appeared to be in excess of the specification. (This is one of the areas where further work is indicated, and as further results become available I will report them.)

My major reservation regarding the THD tests is in the relatively high 15-20kHz distortion. I feel this is not a totally valid picture of Ampzilla's performance in this area, and may be partly set-up related, because a subsequent test on other units of the same make did not achieve results even as good as the above. So at least some, if not all, of the key to good measurements as a well de-bugged test lashup. At any rate, this data clearly represents exceptional performance over the major portion of the frequency range, since in most cases we are talking about THD at or below 0.01%, even up to 200 W.



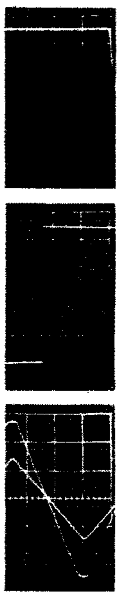
I spent a major portion of the testing time in taking IM measurements, and the results obtained here also reflect in a conclusive way the quality of Ampzilla's performance. During these tests I evolved a very positive method of bias setup, which requires only a DC meter capable of reading 50mV or less with reasonable accuracy.

Fig.3 details my 8 Ohm IM measurements, both channels driven, with the 0dB reference equal to 200 watts of output (per channel). Note that the worst of the two is 0.045% at rated output, and at lower levels it drops sharply to below 0.01%. In fact, at any level below 20 watts of output the IM is less than 0.01%, and the A channel is actually at the equipment's residual of 0.003% over part of the range. The apparent rise of IM at low levels is not truly distortion, but noise limitations of the amplifier. Thus you can see that low level IM rise in this amplifier is virtually non-existent, in view of the fact that 45dB below 200 watts is 6.3mW!

I also took data for 4 Ohm and 16 Ohm operation, with similar quality results.

Experimentation with the bias adjustment revealed a marked effect on low level IM, as I expected. Observing the % IM at the -30dB output level with max full scale sensitivity (0.1% on the Crown IMA), you can bring bias up from zero until the IM drops to a minimum and ceases to decrease. Past this "knee" point, further bias increases had no discernible effects on IM. By monitoring the drop across either of the 0.39 Ohm emitter resistors in the output stage (R43 or R44), the DC bias current in the output may be measured.

In this amplifier, 20mV across these resistors was the magic number (for both channels) beyond which distortion decreased no further. To allow for aging and to provide a safety factor, I recom-



12W square

Beyond the sheer power, its definition and clarity are impressive. Of course this type of evaluation is subjective, and a factor which we can't at present reduce to a number or spec which will predict how it sounds. Until we do, our ears must still be the final judge (as they always should be). In this particular case, I would have to say that Ampzilla is one of the finest, if not the finest, power amplifiers I have ever heard.

In addition to this aural accuracy, Ampzilla has an exceptional (and welcome) absence of on-off thumps, being well behaved in turn-on and turn-off characteristics.

Comments

This report has described the building, de-bugging and performance of the stereo power amplifier, "Ampzilla," from a kit. The construction of this kit I would not recommend to anyone but the advanced audio amateur with appropriate equipment. Even then, you must take the utmost care and really know what you're doing to prevent possible disaster, or performance short of maximum.

For optimum performance of the input stage, I recommend to any kit builder (even if you have already completed the unit) the matching of the input stage components, unless you have already measured perform- power amplifier--your graphs and your ears will both testify to that fact. It will also most probably remain so for years to come, in view of its lineage.

References

1. Bongiorno, James, "Get 400 Watts of Clean Stereo Power with Ampzilla," *Popular Electronics*, September 1974.
2. Ampzilla Review, *The Absolute Sound*, Vol.2, #5, Fall 1974.
3. Ampzilla Specification, *The Gasette*, Vol.1, #2, 1975.

MANUFACTURER'S COMMENT

THANK YOU FOR SENDING ME a draft of your review of Ampzilla. I must say that I was quite surprised after reading Walter's manuscript. To be very frank with you, I honestly expected to be burned at the stake. Quite the contrary, I think the review is exceptionally kind considering the circumstances. Indeed, Walter did receive the very first Ampzilla kit, and I can flatly state that his being a guinea-pig was slightly unfortunate, since the kits being sent out today are a world apart from the one Walter received.

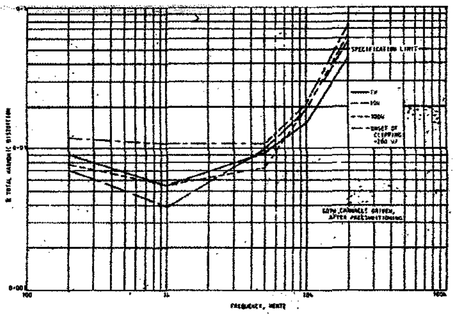
The enclosed manual, which I hope you will pass on to Walter for further comments, will make all of the in terror, and for the first hundred kit builders, I am glad I was at least miles away from them in order not to bear the brunt of maniacal cries of violence.

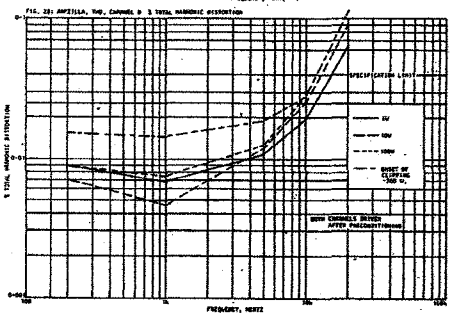
You have my full permission to publish this letter as a full apology to those people who received our first product. We just did not have the combined fifty years of experience of Dynaco and Heathkit. Anyway, I am not going to make many waves but rather just a few comments concerning the status of Ampzilla today, in order to show that we are indeed truly concerned that our product shall be righteously received. I will take these points in as much order as I can:

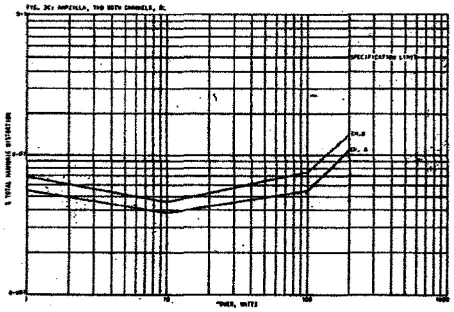
1. All Ampzilla kits sent out as of June 1, 1975, have a 100% revised kit builders' manual. As you will note, it has full illustrations and captions and check-out procedures and schematics, &c. &c. Furthermore, Ampzilla is now available only in metered form.
2. The transformer supplied in Walter's kit is indeed an early one and does not have the correct supply voltages. The supply voltage of Ampzilla right from the start, except for the first fifteen prototypes, all supply the correct voltage of ±75 Volts DC..
3. Power transistors used in Ampzilla are 30 Ampere devices and not 16 as quoted by reviewer Jung.

layout diagram supplied is in full color, as you can see by the enclosed manual; the original Walter received was a black and white velox.

5. We are on our third layout change (for mechanical parts only) on the PC boards, and all marking and screening has been vastly improved over that on the original.
6. Contrary to what Walter states, D5, a 51 Volt Zener, *does indeed* have a polarity dot denoting the cathode.
7. The kits supplied today have a totally re-worked L bracket for supporting the sixteen TO66 transistors. We found the holes on the first brackets far too large which caused the transistor case itself to deform, thus biting through the thero-film wafers causing short circuits. This has been rectified and for the last four months the hole sizes on the L bracket have been reduced from .250 inches to .187 inches. Furthermore, a special tooled plastic insert is used between the PC board and the L bracket. This plastic wafer has flanges which project through the holes being flush with the seating underneath the transistor. This of course makes the effective hole size around the transistor even less, thoroughly eliminating any possibility of short circuits. Since adopting this new procedure,







full output, and represents a peak power of over 300 watts into 8 Ohms. Here the rise and fall is slew-rate limited to about 20V/μS, yielding a rise/fall time of 5μS. This perhaps best indicates Ampzilla's transient response, which is indeed excellent. It is however longer than the updated specification claims, namely 2μS or 40V/μS.[3]

At the other frequency extreme, 4e shows a 20Hz square wave response at the same level. Note the barest suggestion of tilt, indicative of the extremely low LF 3dB point. Again, the power level is over 300 watts.

time) 2V/div V, 1μs/div H. Fig. 4C, bottom, 10kHz, 1W square wave (falltime) 2V/div V, 1μs/div H.

4f shows another aspect of performance, high frequency overload recovery time. The lower level waveform is a ¼ power 20kHz triangle wave, the higher amplitude shows clipping and subsequent recovery time, which is only a few microseconds.

Listening Tests

After all is said and done with measurements, the ultimate test is with the ear. We all are familiar with the "tests good, sounds bad" story. Fortunately, with Ampzilla the good measurements correlate with good listening.

Although I have lived with the sound of Ampzilla for no more than a few months as yet, it does have a sound of its own. This is not to imply sound coloration, rather the opposite. It has a smooth, warm sort of sound which seems pleasant, even when the source material is less than optimum. With first rate sources, the sound reminds you again what high fidelity is all

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be allowed to get into your clothing. It is extremely difficult to remove.

10. I do agree that the use of a variac is absolutely the best insurance when first turning on the amplifier with a very small signal of 100mV input running through the amplifier. One can observe a very distorted sine wave as the variac is turned up slowly. As the variac is increased the sine wave will of course begin to look better and better, indicating that the amplifier is operational. *We do not advise* using the 1K 2 watt resistor as Walter suggests. They do not offer enough protection in case of a malfunction. The present kits are supplied with ¼ Amp fuses for this procedure and are obviously infinitely faster than waiting for a 1K resistor to burn up.

11. I firmly agree with Walter that it is inadvisable to try to adjust the amplifier's bias to 2.1 volts as stated in the original manual. If you haven't distortion measuring equipment available, then the correct procedure would be to adjust the bias for between 20 and 30mV of drop across either of the .39 Ohms resistors.

12. Ampzilla easily passes the new FTC pre-conditioning requirements, and even though the temperature may feel noticeably warm, it is quite safe, as our thermal cutouts are set at a low 70° Centigrade.

13. I suspect that Walter's unit has some layout or other contributing inaccuracy, because his measured 20kHz distortion is too high. We adjust factory-wired Ampzillas for .04% THD at full power at 20kHz when the amplifier is cold, and after warm-up it automatically reduces. I do believe that there may also be some possible set-up errors in testing since the Sound Technology instrument, while a superb piece of gear, has some unique set-up related problems.

14. Regarding the square wave tests, I believe there are some errors possible due to the test set-up. This is indicated by the statement and photo showing some overshoot. When Ampzilla is built correctly, the layout is neat and the test set-up to measure is done correctly, there will be no overshoot, even with full power square waves. The reason I believe the test set-up is contributing some error is that the measured rise and fall time is 5 microseconds, which is too slow. Furthermore it seems to me this test was measured beyond the stated specificactions of 200 watts. If Ampzilla is driven to the clipping point with square waves, the output power delivered is over 400 watts, and under these circumstances many other circuit parameters begin to have effects on performance. Furthermore, it is vitally important to make absolutely certain that the rise and fall times of the signal itself actually get into the amplifier and are not lost within the cable path. The only proper way to measure the true speed of the amplifier is to use 50 Ohms terminations at all points leading to the input. This will, of course, ensure that the speed of the input signal itself is far greater than the response of the amplifier.

15. I have saved this resistor matching situation for last, and I hope anyone intending to build Ampzilla will fully understand that the modifications prescribed by Mr. Jung are totally unnecessary. The kit he received probably did not have matched devices with it. All Ampzillas are now supplied with matched transistors for the critical input stage. Therefore, any additional selection is totally unnecessary. We can attest to this because we have had virtually no problems relating to these components. These components are all selected and matched for both factory-wired units and kits.

Again I want to thank you very much for your interest in our product. If I can be of any further help or service to you, please do not hesitate to contact me.

JAMES BONGIORNO, President
The Great American Sound Co., Inc.

WALT JUNG REPLIES:

3. 2N6031 and 2N5631 transistors are on the Ampzilla's parts list, and the Motorola catalog lists them as 16A devices, thus the comment. Obviously I had no way of knowing the GAS part numbers are selected units--but this should also make it clear that the 2N numbers are *not* completely equivalent and should not be listed as substitutes!

7 & 8. I still like mica washers and aluminum. I've never seen one cut the way the film units do, and have never lost a transistor because of them.

10. I did not devise this method to burn up 2 watt resistors, but to allow a voltage drop which could be measured to indicate trouble and yet be safe.

14. I believe these comments to be a misinterpretation of the data. Small signal rise and fall times are clearly just about 2μs, as shown by 4b and 4c. 4d shows slewing ability, or large signal risetime of 5μs. This is from the same 50Ω generator (at a higher level), so the difference is not in the setup.

The peak voltage was carefully set to 50V which is below the 200 watt, 8 Ohm sine wave level which is, of course, 56V peak (40V RMS). So I'm quite sure it was not clipping, and the measurement is within reason as far as actual performance goes. As I said, however, I don't fault the amplifier for this performance, it is good. I just wonder why it does not agree with the specification cited, unless the 40V/μS rating applies to small signals only.

15. A flat brand of "unnecessary" regarding my modification of the input stage is really not an answer to the issue, but sounds to me like a dodge. No question that my transistors were unmatched--the data fairly screams this out. Beyond that, the resistor tolerance tightening and matching is an unquestionable improvement, and enhances balance to a degree impossible with unmatched pairs. As to whether it is desirable or worthwhile to effect improvement in "the critical input stage" (Mr. Bongiorno's own words), I think so. I also think my measurements, for both DC and AC performance, particularly the IM measurements, speak for themselves.

I don't particularly like the dismissal of a fair amount of work to correct a design oversight as "unnecessary." Most people reading the write-up on the input stage will conclude something was wrong, and when all was done, things were in a better state due to my changes. If Mr. Bongiorno feels this is unnecessary, so be it.

OPTIMIZING AMPZILLA'S INPUT

WHEN I BENCH CHECKED the drive boards for Ampzilla, I found one had inadequate range in its bias trimmer, which is supposed to set the output to 0V DC. Taking a closer look at both, on the board which would zero, I checked the range of trim and found it to be asymmetrical, rather than ±0.6V. Fig. B1 is a simplified DC circuit of Ampzilla's input stage, which will be used to explain how this was happening.

Here R5 is the bias trimmer, which has a range of ±0.6V DC, intended to zero any DC offset generated by the Q1-Q4 dual differential input stage. Of course if Q1 through Q4 and the associated components were perfect, there would be no DC offset, and the R23-R24 junction would be the same potential as R5's arm. Then R5 could be set for 0V DC, and the output would sit at 0V DC, which would make R5 superfluous. But the presence of R5 tells us something about the circuit. Further, the fact that R5 cannot adjust out all of the offset tells us more.

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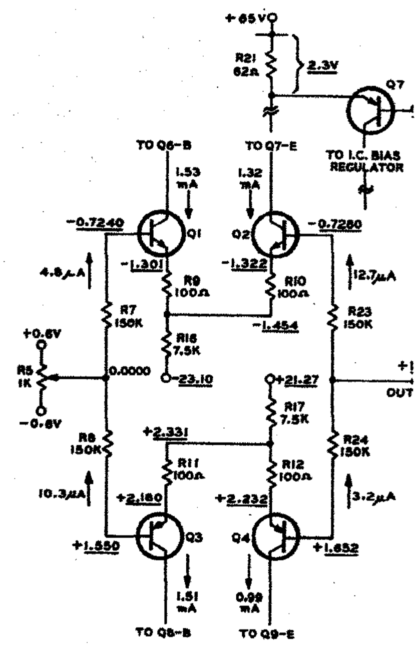

Fig. B1: Measured DC conditions on a sample Ampzi... input stage.

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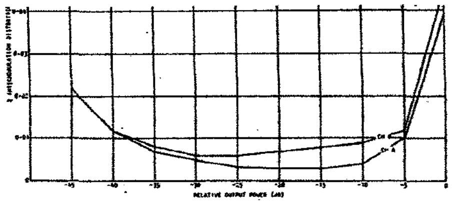
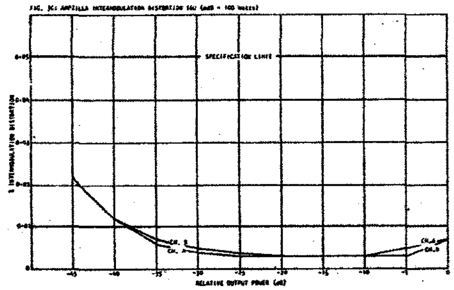
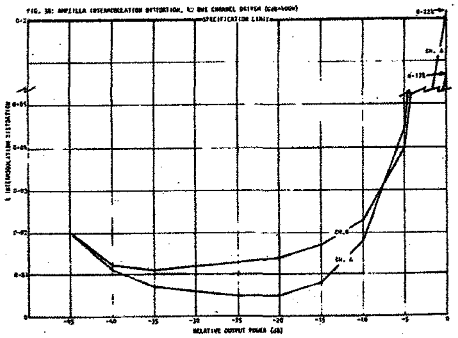
should allow you to achieve results comparable to those reported, which are exceptional.

In final summation, building, testing, and using Ampzilla ranks as one of the outstanding experiences in my audio lifetime. Because of the problems mentioned, it was the most trying kit I have ever completed, and at times was frustrating almost to the point of bitterness. On the plus side, though, having "tamed" Ampzilla is a reward which truly can be savored, not just because of the sense of accomplishment of a victory in battle, but by the continuing experience of its sonic delights. The over-all impression I'd like to leave with you is a positive one. Although in this review I have criticized several aspects of Ampzilla as a kit, the comments have a positive objective: because when you successfully complete this amplifier and achieve its characteristic performance, you will possess a state-of-the-art







indeed happen once in a while, and of course we will replace defective ones immediately.

9. We do agree that building the heat sink is quite a messy job. However, the most important thing you should understand is that the white thermal compound ought not to

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Digging into the circuit and measuring the critical voltage drops gave me the values indicated in Fig.B1. Actually four resistor tolerances can cause unbalance *per pair* of transistors, as well as the transistors themselves. These are R7-R23, R9-R10 for Q1-Q2, and R8-R24, R11-R12 for Q3-Q4. Further, the magnitude of voltage drop across R7-R23 and R8-R24, about a volt, is not at all conducive to base voltage balance at Q1-Q2 (or Q3-Q4) should these resistor pairs be mismatched, or the base currents mismatched.

We are talking about *a few tens of millivolts* of difference voltage to these pairs to upset current balance. If the base resistors drop 1 volt apiece, a 10% unbalance (permissible with 5% R's) yields 100mV of difference. When you double this possibility with the 2nd differential pair, then add the effects of transistor mismatching (the kit transistors are unmatched discrete units, MPS U56 and MPS U06's), you can begin to appreciate the likelihood of unbalance.

I made a great number of tests on these boards to evaluate the best

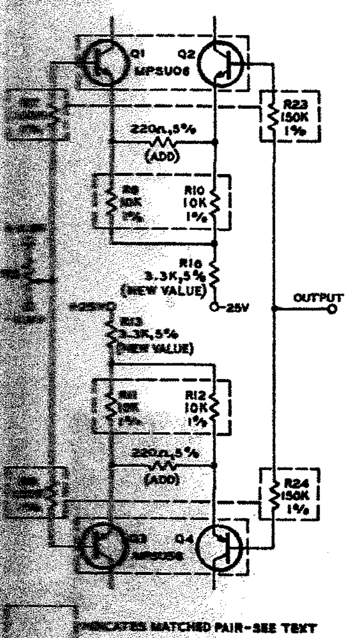


Fig. B1: Modified Ampzilla Input Stage.

and simplest change which would effect improvement. Of these, matching the resistors mentioned and both pairs of transistors made the greatest improvement. I modified the DC feed paths to the emitters slightly, namely value changes to R9, R10, R11, R12, R16 and R.17. These changes are indicated in Fig. B2.

I changed R9-R10 (and R11-R12) to 10K 1% types which tend to force the emitter currents of both pairs to match, in spite of other parameters. This also necessitated a value change to R16 and R17 to retain the same DC currents. Then, to retain the same value of DC emitter coupling, I added a pair of 220 Ohm resistors between the emitters (on the component side, between R9-R10 and R11-R12). Both the 3.3K and 220 Ohm units can be 5% types. For details, see photo, Fig.B4.

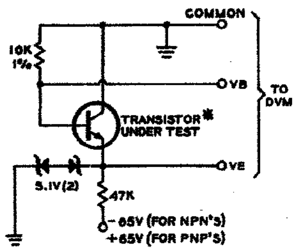
To match the transistors into like pairs, you must test all the units supplied to log their V_{BE}'s. This can be done with a relatively simple circuit such as B3, using the Ampzilla power supply voltages. Plug the units in one by one *[turning on power after insertion.—Ed.]* and allow each to stabilize within a millivolt. This takes a little while as the transistor warms up. Fig.B3 details a set of readings on six MPS U06's.

From the gathered data, try to pick a pair which match up in the V_E column to within 5mV of one another. Don't worry about the absolute voltage, just the match. For example, units ##1 and 2 are a good choice from these (I actually used them), and ##3 and 6 would be next best. H_{FE} should also match, but from what I've seen this follows if the V_E's match.

Do this for both the MPS U06's and MPS U56's, and place the matched units in the Q1-Q2 and Q3-Q4 sockets of each board. The remaining transistors can be used elsewhere.

The best way to match the 10K and 150K resistors is to select pairs from a number of 1% units. If you can obtain a quantity of resistors from the same manufacturing batch, you will probably be able to match them to much better than 1%. 10K 1% units for example will be within 100 Ohms of 10K, but with careful selection you can find pairs which will be 5 to 10 times closer to one another. A 20 Ohm differential would be 0.2%, 10 Ohms, 0.1%, etc. Again, don't worry about the absolute value, just the match.

For the 150K units, the matching is most important because of the high DC voltage they drop in the circuit. In experimenting with the biasing of the circuit I temporarily changed these 150K units to 10K matched pairs. With the change I



**NPN shown; can be either type with appropriate supply polarity.*

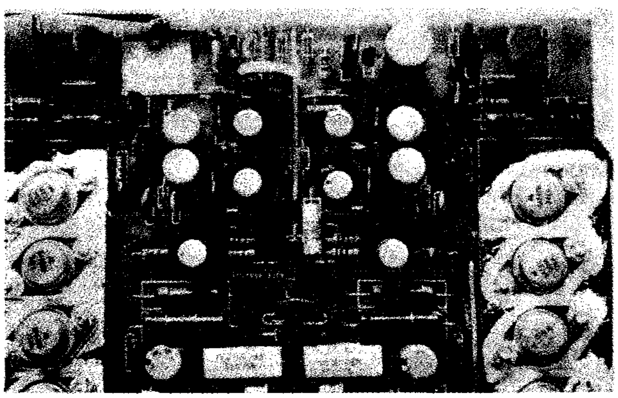
Test Sample	V_B	V_E	HFE (Calculated)
#1	.0612	.6588	229
2	.0586	.6540	239
3	.0711	.6711	197
4	.0715	.6740	196
5	.0741	.6791	189
6	.0673	.6700	208

Fig. B3: Test Circuit for Matching Input Transistors.

noticed that a significant improvement in balance and DC stability came about, for the reasons mentioned above. This change could present serious problems, however, as it lowers the input impedance to 6K, a figure not compatible with many preamps, and it also lowers the gain. Further it raises the LF 3dB point from 0.02Hz to 0.159Hz, which is less disastrous, but it would deteriorate the 20Hz LF square wave response.

In light of this, the only alternative is to match the 150K resis-

Fig. B4 below shows the author's added 220 Ohm resistors and the new 1% types he added.



tors as close as practical. I was able to find pairs matched to within 0.05% or less (75 Ohms). Once you have your matched pairs selected, place them in the positions indicated in Fig.B2.

After these changes, the DC offset in both channels was less than 15mV, which is quite good. Currents were matched as well as could be measured, and the R21 voltages were 1.5V, indicating happiness here also.

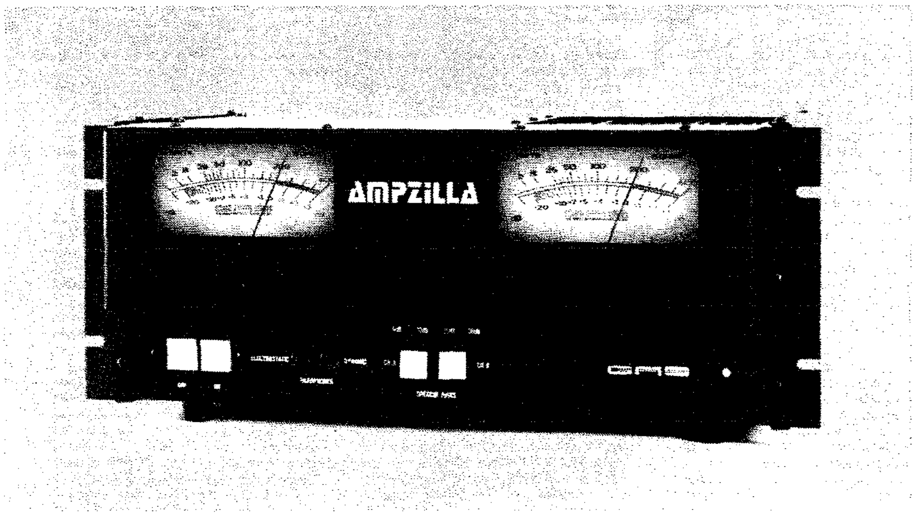
If you're wondering about the real necessity for this, remember that a DC offset biases your speakers, and also causes unnecessary dissipation in the output stage. It also detracts from the advantages of the symmetrical input stage, as it is obviously no bnger completely symmetrical when offset. Without the change Ampzilla takes quite a while to stabilize after turn-on, which may be the reason one reviewer has already commented on this point.[2]

Unfortunately, however, you need precision test equipment to make these measurements. I used a 4½ digit DVM, and it takes precision resistors. Should there be sufficient interest in these, Old Colony Sound Lab will consider a kit for the matched components.

ALAS, ALACK

While checking proof on this issue we learned that G.A.S. will no longer offer the kit Ampzilla.

Price on the factory assembled unit is $809. from your local dealer. G.A.S. tell us they will sell you a manual for $2 postpaid. Great American Sound Co., Inc. 10929 Vanouwen St., N. Hollywood,CA 91605. Oh well, Walt is preparing reports on Heath and Dynaco units.



AMPZILLA'S NEW LOOK

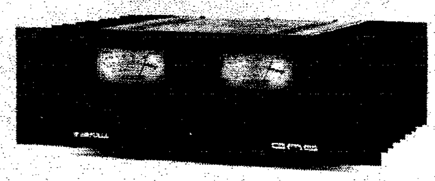
Augmenting Ampzilla's familiar look is the addition of two headphone jacks on the front panel. One jack accommodates conventional electro-dynamic headphones; the second jack has higher-voltage output for use with electrostatic headphones.
Internally, Ampzilla's power transformer is now supported by heavy-duty steel bracing to withstand the most severe handling and shipping conditions.

SON OF AMPZILLA

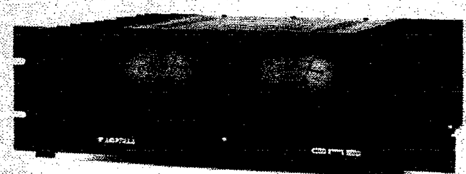
Shown here are the choices available for the Son of Ampzilla amplifier. Each day's mail brings us more glowing reports about its excellent performance with a wide variety of speaker applications including two pairs of Magnapans or two pairs of Quad electrostatic speaker systems. The resulting popularity of Son of Ampzilla has resulted in our need to expand the Great American Sound Company production area to the 20,000-square-foot facility shown on the front cover of this Gassette.

Utility
(W) $399.00
(E) $409.00

W/Blk. anodized
Front Panel
(W) $414.00
(E) $424.00



W/Blk. anodized
Rack Mtg. Panel
(W) $424.00
(E) $434.00



(E) = East of Denver (W) = Denver/West

NOW AVAILABLE

INDUSTRIALIZED AMPZILLA AND SON OF AMPZILLA

For those heavy-duty applications where long-term reliability under adverse operating conditions is more important than minimum distortion in the ultrasonic response region, both Ampzilla and Son versions for industrial usage. Both these units have black-anodized finish and are supplied with mounting provisions for installing in a standard 19-inch commercial rack.

StereOpus

volume 1
no. 3

StereOpus is published four times annually at P.O. Box 269, Fort Walton Beach, Florida 32548.
Rates are $9.00/year ($11.00 for First Class). Foreign rates are $12.00 ($15.00 for air mail). Canadian rates are $11.00 (First Class only).

Thaedra

Stereo Preamplifier. Manufacturer: Great American Sound Company (G. A.S. Co.), 20940 Lassen Street, Chatsworth, California 91311. Price: $899.00

My comments on Thaedra are based on an early production unit. They are an indication, but not an absolute one, of what you will find on a dealer's shelf right now. Several important modifications have been made, and I hope to be able to audition a current sample in the near future against the Mark Levinson and several other hot contenders. Based on this first sample, Thaedra has a low end second to none, a very good middle, and an excellent top. My sample trounced my SP-3a-1 at the bottom and top, and was very close to it in midrange with respect to naturalness and transparency.

I discovered that the Denon cartridge (which has a medium output and can be used with or without a head amp) *(see review of Denon this issue – Ed.)* definitely sounded better through Thaedra's head amp than it did through the standard phono input, even though the head amp would occasionally sound strained by the high output of the Denon. Modifying Thaedra's head amp for use with higher output cartridges like the Denon is a simple procedure, so if you do plan to use yours with such a pickup, then write to G.A.S. for details. *(In most cases I suspect they will want your friendly dealer to do the mod – Ed.)*

One reason the head amp sounds better than the standard phono input (using the Denon) is the more advanced circuitry of the former. In fact, the term "head amp" was used by G.A.S. to distinguish it from pre-preamp. It is not a pre-preamp at all. The signals amplified by the head amp are passed directly to the high level stages. They never go through the regular preamp circuits. Early Thaedras were reported to have rather sensitive head amps (sensitive in the sense that if you plugged a lead into them when they were on, they just might self-destruct), G.A.S. reports that Thaedra's now in production are no longer so delicate.

The advanced circuitry used in the head amp, and throughout the rest of the preamplifier (with the exception of the normal phono input stage), is servo-control. This technique, exclusive to Thaedra, absolutely controls D.C. voltages in the preamp, without resorting to excessive negative feedback or coupling capacitors. The result is to allow the preamp to be completely D.C. coupled after the input coupling capacitors in the phono stage.

A great deal of time was spent comparing Thaedra to the Luxman preamp, also reviewed in this issue. Using Dahlquist DQ-10's, Thaedra gave top. It was very difficult to judge the two in terms of midrange accuracy with the DQ-10's, so I took them to a friend's house and compared them on his Dayton-Wrights (electrostatics). These speakers have to be the ultimate for equipment comparison. As I expected, the DW's made small differences in the midrange seem huge – in favor of Thaedra. Massed voices were more defined and not nearly so veiled. Top end definition was superior on Thaedra this time, but the DW's have a rolled off top and the Lux's tube-like highs weren't really as much in evidence as they were with the brighter DQ-10's. When the head amp was used, overall reaction to Thaedra by a number of experienced audiophiles was very good.

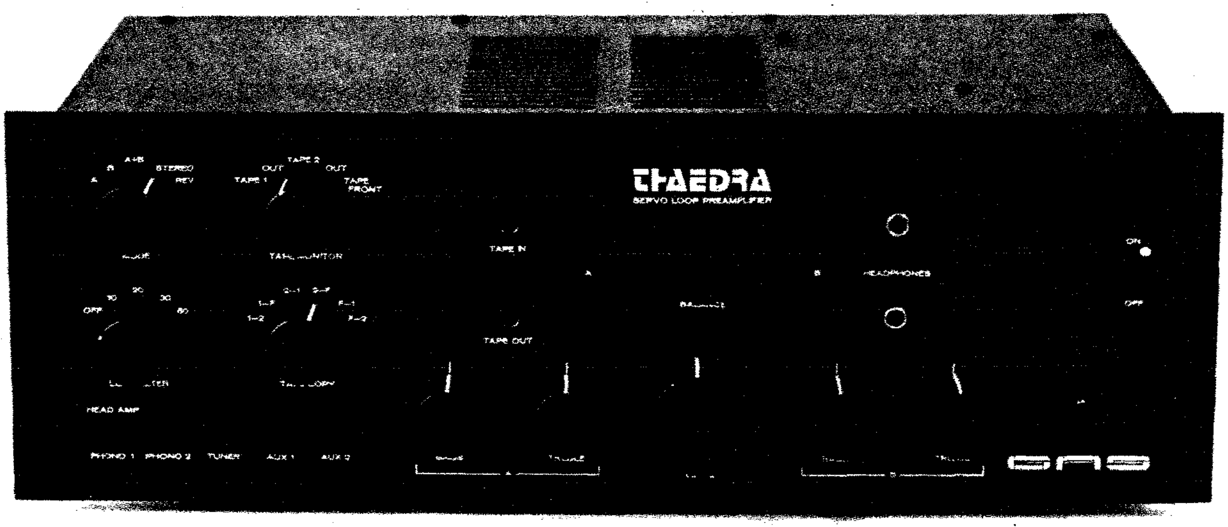
According to G.A.S., Thaedra's now in production are noticeably superior to first samples (sonically). If this is true, Thaedra may indeed be hard to beat at any price. I can't fail to mention that construction of Thaedra (inside) is really impressive, and the thing is every bit as sexy looking as the company's advertisement. A walnut case is available too.

RT

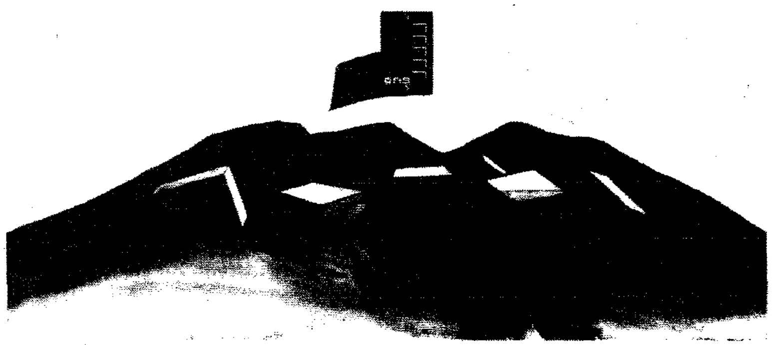
While agreeing with RT on the bass and midrange of Thaedra, I initially had some reservations about the high end. The unit was returned to G.A.S. for updating to the latest specs. On return to us, the preamp unfortunately had an intermittent channel. While it was operating it indeed appeared to be a considerable improvement over the first sample. We will have to return the unit again, however, to cure the bad channel. A full update will appear in the next issue.

FOOTNOTE: The Thaedra ads are sexy only in a rather kinky way – have a banana?

TJN



MEET GOLIATH



Once upon a time, there was a moving coil born into the kingdom
This moving coil was a child of beauty, something the kingdo
had awaited eagerly. However, when the child finally arrived,
she was treated terribly. She was booed and cursed and threatene
to become a prisoner of mishandling and misunderstanding. Sh
was shoved through transformers and subjected to the evil dee
of medieval electricians. For years, she suffered the tortures
a thousand ages.

Finally, one day, a magic fairy named Thaedra saw the real inner beauty of the moving coil. Thaedra proclaimed to the lar the glory of the moving coil and then the kingdom became awa of its new princess. As the fairy queen Thaedra nursed the moving-coil princess to adulthood, she realized that a prince must be found to complete the happiness of the moving-coil princess's life. Lo and behold, one day, a gleaming knight on white horse arrived in the kingdom. His name was Goliath. Instantly, Goliath and the moving-coil princess fell in love an lived together happily ever after.

COMPARE THESE SPECS!

THOEBE

MAGNETIC PHONO:

Gain: 42 dB to tape output.
63 dB to main output.
Noise: 500 Nanovolts — 20 Hz to 20 KHz referred to input.
Distortion: Less than .01% at 2 Volts R.M.S. output at tape output at any freq. 20 Hz to 20 KHz.
RIAA: ±0.5 dB, 20 Hz to 20 KHz.

HIGH LEVEL:

Gain: 20 dB to main output.
Noise: 3mV, 20 Hz to 20 KHz referred to input.
Distortion (Tone controls flat): less than .01% at 2 Volts R.M.S. output at any freq. 20 Hz to 20 KHz into 600 Ohms.
Freq. Response: 1.0 to 100 KHz ±1 dB (Tone controls flat).
Low Filter: 10 Hz, 20 Hz, 30 Hz, or off.

Maximum input before clipping:
Phono: 100 mV at 1 KHz.
High Level: 1 Volt R.M.S. (level control at max.)

Maximum output before clipping — all outputs:
10 Volts R.M.S. minimum.

Power Consumption: 115-125 Volts, 50-60 Hz, 50 Watts.
Size: 17" W. x 5¼" H. x 8" D.
Shipping Weight: 30 lbs.

PRICES	BLK. PANEL	RACK MTG. PANEL
Denver/West	$499.00	$534.00
East of Denver	$509.00	$544.00

GOLIATH

GOLIATH PRE-PREAMP

Gain: 29 dB (Also selectable 26, 23, 20, 17 dB).
Noise: 75 Nanovolts — 20 Hz to 20 KHz referred to input.
32 Nanovolts — 400 Hz to 20 KHz.
Distortion: Less than .01% at 2 Volts R.M.S. output at any freq. 20 Hz to 20 KHz.

Max. input capability: 200mV. (at max gain).
Freq. response: 20 Hz — 20 KHz ± 0.1 dB.

Power requirements: Supplied by Thoebe.
Size: 5¼" H. x 2¼" W. x 8" D.
Shipping weight: 5 lbs.

Price: $149.00.