



VAC PA100/100 POWER AMPLIFIER

Operating Instructions

DO NOT OPEN THIS UNIT - NO USER SERVICEABLE PARTS INSIDE. DO NOT REMOVE THE BOTTOM PLATE. LETHAL VOLTAGES ARE PRESENT WITHIN THE CHASSIS. DO NOT EXPOSE TO MOISTURE OR OPERATE IT IF WET

VACUUM TUBES BECOME HOT ENOUGH TO CAUSE SERIOUS BURNS. NEVER TOUCH A TUBE WHEN THE UNIT IS ON. IT MAY TAKE SEVERAL MINUTES FOR THE TUBES TO COOL DOWN AFTER THE UNIT IS SWITCHED OFF.

DO NOT PLUG INTO AC UNTIL ALL CONNECTIONS ARE COMPLETED.

Introduction

The VAC PA100/100 is a single chassis wide-band low-feedback stereo amplifier conservatively rated at 100 watts per channel. It is to be operated only from the voltage visible on the configuration card located under the fuse. Please contact VAC or your dealer if the voltage in your area does not agree with the label. The fuse is a slow blow type of the size noted on the back of the chassis. A tube cage is available as an option.

The input circuit of the PA100/100 is derivative of the Williamson design, which was first published in England in 1947, and was the mainstay of the original high fidelity movement. Notable features of this circuit include a direct-coupled input amplifier and phase splitter, resulting in low phase shift, and inherent precise balance of the phase splitter (if properly executed) at all frequencies and levels, resulting in excellent push-pull balance, stability, and low distortion.

The output stage is derived from the renowned PA90C, featuring individually adjustable "fixed-bias" and partial-triode ("ultra-linear") operation.

Premium parts are employed throughout, including 14 pound 22 section bifilar-wound ultra-wideband output transformers, polypropylene and polystyrene signal capacitors, high current rectifiers, low ESR power supply, and proprietary wiring. The quality of parts and careful layout allows the use of very little feedback for high sonic purity and low distortion.

Unpacking

Each tube socket on the amplifier is covered by a small round sticker. The color of this sticker corresponds to the color of the sticker on a tube. Fit each tube into the matching socket, first *removing* the sticker from the tube and socket. The bias levels for the output tubes have been factory set, but should be checked during the installation procedure.

Installation

Physical requirements:

- 1) Provide adequate ventilation - allow at least 3 inches above and 1 inch to each side.
- 2) Do not place in a completely enclosed cabinet.
- 3) Do not stack other equipment on top of the VAC units.
- 4) Do not operate on carpet or any other surface that might block air flow.
- 5) The chassis and power transformers will become hot in normal use.
- 6) Do not allow the chassis of the VAC components to touch any metal parts, such as the frame of an equipment rack. This might create a parallel ground path that will degrade the sound of your system.

Electrical connections:

- 1) Complete all installation steps before plugging the amplifier into the AC mains supply.
- 2) Connect signal inputs to the power amplifiers. Single ended interconnect cables equipped with RCA phono plugs provide the input to each channel.
- 3) Connect loudspeakers between the appropriate pair of binding posts on the back of the power amplifiers. Most popular speaker cables can be accommodated by the output posts. Output impedance matching is available for loads of 2, 4, or 8 ohms. Connect one lead of the speaker cable to the "G" position, and the other to either 2, 4, or 8. The "G" terminal is at ground potential, and the amplifier does not invert phase.
- 4) Do not connect two amplifier outputs to each other.
- 5) Connect the AC cord to the power source indicated by the voltage configuration card under the fuse (100 volts AC, 120 volts AC, 220 volts AC, or 240 volts AC at 50 or 60 Hertz).
- 6) Follow the BIAS procedure described in this manual to set the idle current. Also, read the section entitled INSTALLING NEW OUTPUT TUBES.

Operation

Continuous operation is not recommended. If the amplifiers will not be auditioned for a few hours it is best to turn them off. This avoids undue stress to the KT88 output tubes.

As with all high fidelity products, the sound characteristics of the VAC amplifiers change somewhat as they warm up. Best sound will be achieved after 15 minutes of operation, with subtle changes occurring for up to one hour. However, we advise against leaving the equipment on at all times because of the attendant acceleration of output tube wear. Life of the output tubes averages between 2,000 and 8,000 hours depending upon brand fitted and random variations within the tubes themselves.

Any time that the VAC Power Amplifier has not been used for a few weeks the sound may be different. This is also normal for high resolution audio equipment. Optimum sound should return after a few hours of operation, preferably with an audio signal.

Please note that although your VAC amplifiers have been run for 48 hours at the factory, they will continue to "break in" for approximately 150 hours. Also be aware that many components display the need for a new break in period after being transported in unheated cargo aircraft.

Bias Adjustment

Your VAC Power Amplifier has been shipped with output tube bias preset. This should be checked when you install your amplifier, and periodically thereafter. It must also be set whenever an output tube is changed.

Adjustment of the output tubes is quite easy, and requires only a small screwdriver. On the front panel are four bi-color LEDs, each with an adjacent adjustment control. View the LEDs from directly in front, not from above or below. Adjust the LEDs to be green when the amplifier is not playing music. To set, turn the control clockwise until the LED just begins to change to an amber/red color, and then back the control off just slightly to restore the pure green color.

As music plays, the LEDs will vary from green to red. Check the bias if you ever see an LED stay red while music is not playing, or if an LED does not tend toward amber or red when music is playing. If the flashing of the LEDs is bothersome while listening, the switch on the front labelled "Bias Test" can be set to "0", disabling the LEDs. The switch must then be set to "1" to check the bias of the output tubes.

Any tube that can not be adjusted to the correct bias point should be replaced. Any tube which requires constant readjustment should be replaced immediately. Never operate the amplifier with an LED that shows red when music is not playing.

When installing new tubes, set the bias controls counter-clockwise. Check the bias of both channels as the amplifier warms up - don't wait ten minutes.

Bias levels should be checked monthly to ensure optimum sound quality. It is not unusual for the bias to change with time, particularly when tubes are new. The greatest amount of drift occurs during the first 200 hours of a tube's life. The drift may change direction periodically, such that the bias control must be increased and later decreased, or vice versa. Check bias if the sound seems lacking in detail or dynamics.

Tube Types

The input/splitter tube and the driver tube may be type 12AU7A/ECC82/E82CC or type 12BH7 (typically richer sound). The output tubes are type KT88. Please feel free to contact VAC if you require additional information or advice.

Installing New Output Tubes

Replacement tubes are available from VAC and other sources. Output tubes are KT88 beam power Kinkless Tetrodes (6550 may also be used - see Tips & Advice, Output Tubes). It is not necessary that they be matched pairs, although a slight improvement in measured performance may be achieved in this way. Make certain that each tube fits firmly in its socket. A tube that fits loosely may not make correct contact on all pins and might "run away" (read on). It is best not to mix brands of tubes.

ALL POWER MUST BE OFF. Remove the old tubes after they have cooled down (TUBES BECOME HOT ENOUGH TO CAUSE SERIOUS BURNS WHEN IN OPERATION AND MAY TAKE SEVERAL MINUTES TO COOL DOWN). Install the new tubes firmly and fully in the sockets, taking care to observe the direction of the locating ridge on the plastic center pin of each tube.

Follow the normal turn on procedure and begin the BIAS procedure. While doing this, keep an eye on the plate (the outermost metal structure) of the output tubes. SWITCH OFF IMMEDIATELY IF THEY BEGIN TO GLOW RED. This indicates that the tube is "running away", being destroyed rapidly by conducting excessive current. (Note: with some KT88s a slight dull orange glow may occur over a very small section of the plate, usually at an edge. This is acceptable and not the same as running away, in which most of the plate will become bright orange or red.)

Tubes may run away for several reasons:

- 1) The tube is not fully inserted in the socket.
- 2) The tube fits loosely in the socket and thus can not make correct contact. Such a tube is unusable and should be returned to its seller.
- 3) The tube is defective.
- 4) The bias is misadjusted.
- 5) There is a problem with the amplifier. Contact VAC or your dealer to arrange service.

In the event that trouble is encountered, try another tube. Stop if the problem persists and consult with your dealer or VAC.

Follow the BIAS procedure described previously in this manual to set the idle current at 70 milliamperes per tube, checking the idle current at 1 minute, 30 minutes, 1 hour, and 2 hours.

Replacement of Low Level Tubes

All power must be switched off. Allow tubes to cool down. Remove and replace with new tubes of the appropriate types, noting the location of holes in the socket and pins of the tubes.

Replacement tubes are available from VAC and other sources.

Ultra-linear or Triode?

The input amplifier, phase splitter, and driver stages are triode tubes operated in Class A with no cut-off or grid current. The output stage is connected for partial-triode, well known for low distortion, good damping factor, and high efficiency. This technique was invented by Alan Blumlein of EMI in England, and was popularized in the US as "ultra-linear." VAC can convert amplifiers to triode connection for a small charge.

Care of Chassis & Face Plate

VAC chassis are aluminum for superior electromagnetic performance. The finish is a tough textured powder coat paint. This finish is durable but can be scratched or chipped, just as that of a fine automobile may be damaged. Cleaning with a damp cloth WHILE THE AMP IS SWITCHED OFF AND UNPLUGGED should suffice. DO NOT use cleaning solutions containing harsh detergents or solvents. They may damage the finish or silkscreened lettering.

Tube Cages (Optional)

Perforated metal cages are planned as a future option to enclose the vacuum tubes. Mounting directions will be supplied with the tube cage kit.

Need Help?

Please call us with any questions you may have. It is better to ask than to guess. Our telephone number is (USA) 941-359-2066. Our fax number is 941-359-2057. We can be reached by e-mail at info@vac-amps.com.

Warranty

This amplifier is warranted for a period of thirty (30) days from the date of purchase. In addition, if the registration card(s) is received by VAC *along with a copy of your sales receipt* from an authorized VAC dealer within this thirty days, a service contract will be extended to cover your equipment for three (3) years (except tubes). Receipt of your registration card will be confirmed in writing by VAC.

This warranty applies only to units sold to and operated by private individuals in the United States of America through authorized VAC dealers. For warranty information outside of the U.S. contact the importer of VAC equipment for your country. Units sold outside of the U.S. should still be registered with VAC.

Valve Amplification Company www.vac-amps.com
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Sarasota, FL 34234
Tel 941-359-2066
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Mail this form along with a copy of your sales receipt as soon as possible to:

REGISTRATION FORM
VAC PA100/100

Name _____

Address _____

Telephone _____ - _____ - _____

Dealer name _____ Salesperson _____

Dealer address _____

Purchase date _____ Serial Number _____

How did you first learn of VAC products? _____

Please provide any comments on VAC products or your dealer _____

Tips & Advice

A Word About Tubes in General

It is a truth that each brand of tube sounds different in a particular high resolution circuit. This is because no two manufacturers make a tube type in quite the same way, and the central tendencies of the performance parameters will differ slightly with each maker. To emphasize the point, examine the plate structure of any two 12AX7 from different manufacturers. You will probably find that they may not even the same shape and size. (Be careful here, as often a tube is made by a firm other than indicated on its label. In the heyday of tubes it was common to crossbrand between major labels, such as GE and RCA. Today many labels do not manufacture their tubes at all, including Gold Aero and RAM.)

This sonic variability may at first seem a liability, but further thought will reveal that it is an advantage, just like the ability to adjust VTA on a tone arm. The owner of a tube amplifier can select those tubes which sound like the real thing in his/her specific system. Of course, if the manufacturer you prefer is rare you may want to purchase a few spare tubes for the future.

How long should tubes last? It has long been known in professional circles (and probably now forgotten) that a tube such as the 12AX7 will display better performance characteristics after two years of continual operation than when it was new. In normal use it is not unusual for a low level tube to last 10 years or longer. Output tubes are another story, as they are continually providing significant amounts of current. Here the sound is your best guide. Certainly tubes should be replaced when the amplifiers can no longer meet specifications or when (if you have access to a tube tester) the tube's emission is significantly down or its transconductance is substantially out of specification. In normal use, output tubes will last at least 2 years and perhaps more than 10 years.

VAC will be happy to test tubes for concerned customers. For appropriate fees we can provide transconductance, idle current and/or a photographic record of the tube's plate family curves.

TIPS & ADVICE

A Word About Output Tubes

Your VAC Amplifier can use 2 different output tube types: the KT88 Beam Power Kinkless Tetrode and the 6550A Beam Power Tetrode. We consider the sound of a good KT88 to be superior. Properly manufactured 6550/6550A will work, but may have a slightly higher incidence of failure in the PA100/100. Feel free to experiment with different brands and types to customize the sound to your tastes.

As with interconnects and speaker cables, each tube manufacturer's KT88 tends to have a distinct sound when used in VAC amplifiers, and of course the 6550As sound different as well. Here is a brief summary of our experiences with currently available tubes from different sources.

M-O Valve Company/Genalex/GEC KT88 (U.K.) PRE-1970:

An accurate and sweet tube with good bass quality. Quality is surprisingly variable for a premium tube. World wide supply is limited. *Highly recommended.*

M-O Valve Company/Genalex/GEC KT88 (U.K.) POST-1980:

Hard, glaring sound, only fair detail. Not recommended.

VAC Tested KT88-T:

The best of the versions from China, and our current first choice. Good combination of punch, air, sweetness, and detail. Reliability is very good.

Golden Dragon KT88-M:

No longer available from production, but an excellent tube. A bit more matter-of-fact than the KT88-T, having more of an NOS US tone, but still preserving the airiness of the KT88.

Golden Dragon KT88, KT88 Classic, KT88 Super:

Generally fairly good for sound; reliability somewhat inconsistent.

National NL-KT88-USA:

A version produced by the US arm of the Richardson's organization. Visually very similar to the original and sonically satisfying, slightly lightweight sound, but sweet. Very expensive.

Svetlana KT88:

Several versions have been made, so it is difficult to give a blanket comment. The newest version (as of summer 2000) shows promise, with a sound somewhat similar to the GE 6550A.

US made RCA and Tung-Sol 6550:

Early 6550 type in the "coke glass" bottle. Pretty good sound.

GE 6550A (applies to those manufactured in USA by MPD):

Somewhat soft and lean, with a slightly buzzy character, but fairly sweet.

Phillips/ECG/Sylvania 6550A:

Similar to the GE tube; later production samples may have a somewhat hard upper midrange.

Sovtek 6550:

Samples tested do not bias correctly, having insufficient current flow. Not recommended.

TIPS & ADVICE

A Word About Low Level Tubes

The small tubes (Voltage Amplifier/Phase Splitter and Driver) in the VAC Amplifiers are type 12AU7. This tube is essentially the same as types 12AU7A, 5814, 6189, CV4003, ECC82, and E82CC. The quality of the tube used is by far more important than which of these (equivalent) types is used.

The preferred 12AU7A is the British/Chinese Golden Dragon. Acceptable alternate versions include the Brimar CV4003 (ladder plate version), Mullard CV4003 (very midrangy), generic Chinese 12AU7 (brighter), Sylvania 6189 (darker sound), the GE 12AU7A (slightly forward and grainy) and the Yugoslavian 12AU7 (cohesive and somewhat coarse).

Many classic tubes worth trying if you have access to them, such as those from Telefunken and Amperex, although a caution is in order, as we have recently seen East German EL34 relabelled "Telefunken West Germany." Tubes actually manufactured by RCA, Westinghouse, and Sylvania can be quite good, but the name on the tube doesn't always indicate who actually made it. Other names to watch for are Valvo, Mazda, Tung-Sol, Bendix, Mullard, Brimar, and Raytheon.

TIPS & ADVICE

A Word About Bias Levels

The output stage is designed to operate in rich Class AB₁ at an idle current of 70 milliamperes per tube, at approximately 535 VDC across the tubes. For more technical information about classes of operation see VAC Technical Monograph 90-8.

Some designers erroneously market a lower voltage and current operating point (as little as 26 mA @ 550 VDC) as "Class A₁." Be assured that the VAC and its tubes are strong enough to handle the more demanding, richer bias level.

TIPS & ADVICE

A Word About Impedance Matching

We strongly suggest that you experiment with the three available impedance connections for the best sonic match with your system. Since no loudspeaker represents an unchanging impedance at all frequencies, it is impossible to assert with certainty which output tap is appropriate to use. In many systems an amazing difference in sound will exist between the various impedance taps.

You should consider the output impedance markings on your VAC Power Amplifier as follows:

"8 ohms" matches loads between 4 ohms and 8 ohms

"4 ohms" matches loads between 2 ohms and 4 ohms

"2 ohms" matches loads between 1 ohm and 2 ohms

Most loudspeakers vary outside of any one of these ranges, which is why experimentation is essential. We often find that matching a speaker's minimum impedance is more important than matching its nominal (average) impedance.

If you bi-wire your system (run separate speaker leads from the amplifier to the high and low frequency transducers) you may discover that two different impedance taps work best. For example, with early Martin Logan Sequel II we find that the bass speaker is best matched with the 4 ohm tap, while the electrostatic panel is best controlled by the 2 ohm tap. To achieve this connection, the black leads of both speaker cables connect to "G", the red lead for the panel connects to "2", and the red lead for the woofer connects to "4". With later Sequels we use the 4 ohm connection for both drivers.

Contrary to popular misconception, no power is lost due to unused output taps. Also, the amount of negative loop feedback in the amplifier does not change, being fixed at approximately 6 decibels for all output taps. For more information consult VAC Technical Monograph 90-9.

TIPS & ADVICE

A Word About Output Stage Operating Mode (triode internal wiring option)

Triode amplification is the oldest form known, while partial triode ("ultra-linear") operation of pentodes and beam power tubes dates to 1937. From the engineering perspective, the triode mode differs from the ultra-linear mode in the following ways:

- 1) Somewhat more distortion at low power levels
- 2) Somewhat less distortion at moderate power levels
- 3) Reduced maximum power output
- 4) Output impedance matching is somewhat less critical
- 5) Increased damping factor.

The ultra-linear mode applies negative voltage feedback from the primary of the output transformer to the screens of the output tubes. The ultra-linear circuit displays different characteristics (efficiency, distortion components and levels, etc.) depending upon how much of the primary winding is common to both the screen and plate of the output tubes. The VAC implementation of the ultra-linear circuit has been selected to achieve performance quality as close to pure triode as possible while still increasing power output and efficiency.

VAC can provide directions allowing a skilled technician to convert the output stage to triode operation.

SPECIFICATIONS

The VAC System has been developed with the critical ear as the major arbiter of quality, with both conventional and unique measurements providing insight and guidance as necessary. The lack of emphasis on measurements is due to the fact that engineering's arsenal of equipment and techniques do not operate on the pattern recognition principles that control human perception of sound.

In the immortal words of Daniel von Recklinghausen, if it measures good and sounds bad it is bad. If it measures bad and sounds good you've measured the wrong things.

For those concerned with test bench performance, the following describes typical measured performance of a PA100/100 operated at 120 VAC, 60 Hz.

Power Output:	100 watts continuous average power at 1 kHz into 8 ohms connected to the 8 ohm tap, both channels driven; 103 watts one channel driven.
Frequency Response:	down 0.5 dB at 5 Hz and 64 kHz, ref 0 dB = 1 watt @ 1 kHz. down 3.0 dB at 3 Hz and 115 kHz, ref 0 dB = 1 watt @ 1 kHz.
Power Bandwidth:	down 0.5 dB at 12 Hz and 50 kHz, ref 0 dB = 100 watts @ 1 kHz. down 3.0 dB at 8.5 Hz and 85 kHz, ref 0 dB = 100 watts @ 1 kHz.
Distortion:	< 0.25% THD at 1 kHz 10 watts
Noise:	< 1.5 mv at the output, S/N ratio > 84 dB
Sensitivity:	0.775 volts input for full power output
Negative Feedback:	Loop feedback is fixed at approximately 6 dB regardless of output tap selected.
Absolute Polarity:	Does not invert signal polarity.
Fuse:	Slo-Blow type, 4A for 100 & 120 Volt configuration, 2A for 220 & 240 V.
Power consumption:	300 watts at idle, 516 watts with both channels driven to full power.
Dimensions:	18 " width x 15 " depth x 7.5 " height

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