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The VAC Phi Seventy
Monophonic Triode Power Amplifier
Operation & Maintenance Information



Valve Amplification Company

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PLEASE READ CAREFULLY

Your Phi Seventy is fitted with a thermal sensor circuit. It works in conjunction with the individual indicator lights located on the front panel. It serves two purposes:

- 1) If the idle current of a 300B output tube should drop below nominal limit, the light corresponding to that tube will light green. This indicates that the tube should be replaced at your convenience, but it is safe to continue operating the amplifier.

The exact idle current of each tube may be tested by means of the meter and the test switches. Typical readings are near the dot in the center of the meter. When no test switch is selected, the meter indicates the incoming ac voltage (wall voltage).

Note: These lights will also be green when the amplifier is first switched on, and will extinguish when the bias resistors have reached normal operating temperature after several minutes. The threshold between green and no illumination is not precise; do not be overly concerned if some positions take longer to extinguish. The condition of individual tubes may be checked with the built in meter.

Note: a strong air current could cause the lights to remain green even in normal operation.

- 2) Should any output tube draw excessive idle current (a "run away" tube or a tube with an internal short):
 - A) The high voltage supply in the amplifier will shut down automatically.
 - B) The light corresponding to the bad 300B tube will glow red. The red light will stay on until the power switch is turned off. This tube must be replaced.

The lights for the other tubes will show green after a few minutes...this should be disregarded.

This protection feature normally will operate with much greater speed than the AC line fuse, and provides a high degree of protection against elevated temperature or fire due to a major failure in an output tube. However, completely failsafe methods are not possible. As with any high power electrical device, do not leave the amplifier running unattended. Turn the amplifier off immediately if you smell any strong odor, or if you see any parts glowing orange through the ventilation holes between the tubes.

To minimize difficulties, always source the highest quality tubes, avoiding inexpensive or generic 300B tubes. We recommend obtaining replacement tubes from VAC, stating that they are for use in the Phi Seventy.

CAUTION

THE AMPLIFIER AND POWER SUPPLY CONTAIN NO USER SERVICEABLE PARTS. DO NOT REMOVE THE BOTTOM PLATES OR CHASSIS COVERS. LETHAL VOLTAGES ARE PRESENT WITHIN THE CHASSIS. DO NOT OPERATE THE UNITS IF THEY ARE 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. IT IS STRONGLY RECOMMENDED THAT THE TUBE COVERS BE LEFT IN PLACE AT ALL TIMES.

THE TUBE COVERS WILL BECOME HOT IN NORMAL OPERATION. DO NOT SET OR SPRAY ANYTHING ON THEM.

THE AMPLIFIER AND POWER SUPPLY ARE **HEAVY**. IT IS ADVISABLE TO HAVE ASSISTANCE IN UNPACKING, MOVING, AND SETTING UP. BE SURE TO USE PROPER LIFTING TECHNIQUES TO AVOID BACK STRAIN AND INJURY. BE CERTAIN TO INSTALL IT IN A SECURE LOCATION FROM WHICH IT CAN NOT FALL OR TIP OVER.

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INTRODUCTION

The Phi Seventy is a unique power amplifier. It allies purist amplifying devices with the power and solidity required to control modern audiophile loudspeakers. Extreme linearity is achieved without resorting to loop negative feedback, for a more natural, dimensional sound.

The most noticeable feature of this amplifier is the 300B filamentary triode output tube. Originally designed by Western Electric in 1935 (Footnote 1), it has several extremely desirable features that have kept it in continuous production since that time. An examination of its dynamic curves (Figure 1) reveals it to be a naturally linear device, more so than any transistor device. It gives this superb performance with voltages on the order of 450 VDC, not the 1000-1500 VDC required by other output triodes like the 211 or 845. This lower voltage and lower output impedance allows superior output transformer design, control of the loudspeaker, and safety.

Each 300B tube has its own separate heater power supply and independent cathode self-bias network. This has several major advantages. No user adjustment of any kind is necessary to maintain proper balance of the amplifier. The stabilizing action of this technique upon the idle current (bias point) of each tube is exceptionally strong, and self corrects for large mismatches among tubes or drift with age. This circuit also results in real-world output capability much greater than the test-bench rating would indicate (Footnotes 2,3,4).

A total of four 300B are used in Class A1; that is, they are not operated into cutoff (as in Class AB or B) or driven into grid current (suffix "2" operation) in normal operation. This is the purest, most linear technique known.

The input circuitry of the Phi Seventy is derivative of the unique Williamson circuit, which provides pure, direct coupled, inherently balanced input amplification and phase splitting. Type 6SN7/5692 octal twin triodes do the honors.

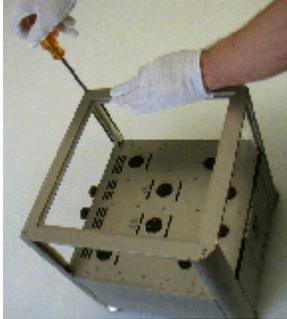
The superb VAC output transformer provides superb voltage/current translation, allowing impedances from eight ohms to as low as one ohm to be driven.

The main chassis is machined from thick aluminum, which is then plated with nickel for enhanced RFI rejection. The separate power supply allows e.m.f. fields, switching transients, and mechanical vibration to be isolated from the audio circuits. The high voltage supply dual choke pi filtering for extremely low noise.

The Phi Seventy is designed not to the latest fad but to substance, for the highest possible sound quality. Time spent familiarizing yourself with this manual will be well rewarded.

UNPACKING & ASSEMBLY

The vacuum tubes and glass covers are packed individually to prevent damage, and must be fitted to the amplifier before installation can proceed.

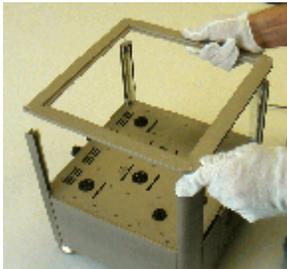


Remove the four screws that secure the aluminum top frame to the chassis pillars using the tool provided. Turn counterclockwise to remove.

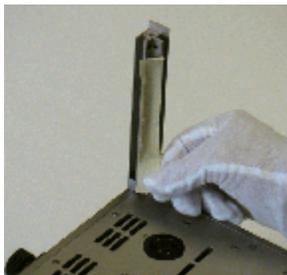
Wear the supplied cotton gloves to minimize the chance of fingerprinting the nickel plated chassis. Wipe any oils off immediately.



Take care to prevent the tool from scratching the chassis.



Remove the top frame.



From each of the four columns remove the tape, which prevented the nylon setscrews from coming loose during shipment.



Slide the side and rear glass plates into the pillars' channels. Note that the rear glass is slightly wider than the side glasses. The glass will not go all the way to the chassis top, but has a gap at the bottom for air flow. Take care not to scratch or break the glass.

The front glass has the etched VAC logo. Install this between the front pillars.
Take great care not to scratch this glass.
The front glass fits into a small channel in the front plate.



Tighten the white nylon setscrews that secure the rear glass and side glasses. Turn clockwise to tighten.

There are four setscrews for each glass plate.

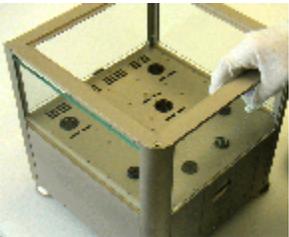
Do not tighten the setscrews for the front glass yet.



Install the six aluminum blocks at the top of the rear glass and side glasses. If there is a 'dimple' in the block, it should face the outside of the amplifier.



Tighten the metal setscrews that secure each block using the allen key supplied. Turn clockwise to tighten.



Replace the aluminum top frame.
Ensure that the front glass fits into the groove in the top frame.
Ensure that the top frame sits flush in the pillars.



Replace the four screws that secure the top frame. Turn clockwise to tighten.

(Note: photo does not show the tubes or glass, which should be installed by this time.)



Tighten the four white nylon setscrews that secure the front glass using the tool provided. Turn clockwise to tighten.

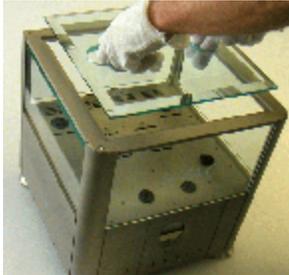
Do not over tighten.

Install the vacuum tubes.

Each tube or its box has a "V" number, which corresponds to the labels on the top plate of the amplifier; these indicate where each tube should be installed.

Fit each tube into the matching socket, first *removing* any sticker from the amplifier and/or the tube. When inserting and removing tubes, handle them by their bases, not by their glass bulbs.

Note that there is a locator pin on the octal (eight contact) tubes that indicates proper alignment. For the 300B tubes, two of the pins are of larger diameter, so that the tube will only fit into the socket one way.



Set the beveled glass top into the aluminum top frame, oriented so that the two holes are on the left and right side.

To prepare a Phi 70 for shipment, follow these steps in reverse order.

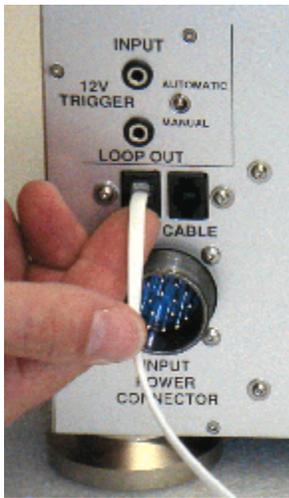
When loosening the metal and nylon setscrews, be careful not to back them all of the way out of the holes! If a metal screw falls into the amplifier, contact VAC for service directions.

NOTE: Do not remove and connect input cables or speaker cables while is amplifier is running. Doing so risks damage to your loudspeakers or the amplifier.

Do not operate the amplifier without a loudspeaker or load resistor attached.

INSTALLATION

- 01) Attach the cord from the power supply to the amplifier and screw the connector collar down fully; this takes many turns.
- 02) Connect the speaker cables; the black lead goes to "Common" or "Ground". The red lead goes to either 2, 4, or 8. If your speaker is rated 4 ohm or 8 ohm, start with "8". For further information see Tips & Advice: Impedance Matching.
- 03) Set the input type switch to XLR or RCA, to match the source and cables. Note: using the supplied adapter, an RCA input can be run into the XLR balanced jack. In such cases, ground isolation is created, which in some systems will quell hum and/or buzz due to system ground loops.



- 04) For traditional stand alone operation, set the 12 volt trigger switch to "manual". To use a 12 volt trigger to control power on/power off, set the switch to "automatic". Also select "automatic" when connecting to the iVAC data buss of the Phi 2.0 Master Control Preamplifier.

- 05) Provide adequate ventilation - allow at least 3 inches above and to each side.
- 06) Do not place in a completely enclosed cabinet. Do not stack other equipment on top of the VAC unit.
- 07) Do not operate on carpet or any other surface that might block air flow.
- 08) The chassis and glass will become hot in normal use.
- 09) Do not allow the chassis to touch any metal parts, such as the frame of an equipment rack. This might create a parallel ground path that could degrade the sound of your system.
- 10) Connect the power supply to the power source indicated on the voltage selector card (visible by the main fuse), either 100, 120, 220, or 240 volts AC. The voltage may be selected by means of the removable selector card located behind the fuse in the power connectors. Remove the cards and reinstall so that the desired voltage may be read; be certain to change the fuse to the correct value.
- 11) Avoid power conditioners that float the ground pin.
- 12) Power requirements are approximately 500 watts per channel. Pay close attention to power quality, and be aware that different power cords can alter the sound.

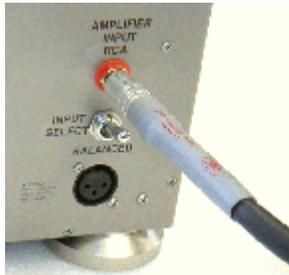
INPUT CONNECTORS



XLR connection, balanced or single-ended, are made to the XLR jack on the rear panel.

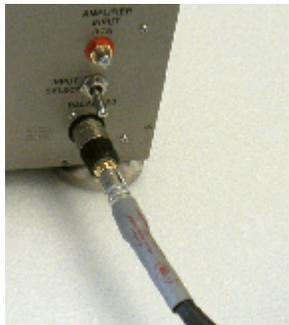
The INPUT SELECT toggle switch is set to the BALANCED position.

The XLR connection follows the EIA “pin 2 hot” polarity convention.



RCA (single ended) connection normally is made to the RCA jack on the rear panel. This is the “direct in” mode.

The INPUT SELECT switch is set to “RCA”



In many systems a lower noise floor is achieved with RCA single-ended sources by using the lower RCA jack adjacent to the XLR input.

The INPUT SELECT switch is set to BALANCED for either the XLR jack or the lower RCA jack.

NOTE: Do not remove and connect input cables or speaker cables while is amplifier is running. Doing so risks damage to your loudspeakers or the amplifier.

Do not operate the amplifier without a loudspeaker or load resistor attached.

OPERATION

By time delay, sound will begin approximately 60 seconds after turn on.

As with all high fidelity products, the sound characteristic of the VAC changes somewhat as it warms up. Best sound will be achieved after about one hour of operation. We advise against leaving the equipment on at all times for safety reasons (see Safety Notice at the front of this manual), and because of the attendant acceleration of output tube wear and power consumption. Life of the output tubes averages 5,000 to 10,000 hours.

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. Refer to the discussion of break in contained in the INTRODUCTION section of this manual for further information.

Please note that although your VAC System has been run for 48 hours at the factory, the break-in time of high resolution audio equipment is infuriatingly long. The Phi sound will continue to season for approximately 200 hours. The early sound of the amplifier will be less extended, dynamic, and coherent. Then the sound will improve noticeably, followed by a period of darker sound, finally giving way to the desired musicality. Patience is a virtue.

Also be aware that many components display the need for a new break in period after being transported in unheated cargo aircraft.

INSTALLING NEW OUTPUT TUBES

Output tubes are type 300B. Replacement 300B output tubes should be purchased from VAC. It is important that the tubes be checked for any tendency to mechanical or electrical shorts (see Safety Notice at the front of this manual). It is desirable that tubes be in matched quartets for each channel, and be close to the "bogey" values for the major parameters. Make certain that each tube fits firmly in its socket.

ALL POWER MUST BE OFF. Remove the top glass and the old tubes after they have cooled down (THE COVER BECOMES QUITE HOT IN NORMAL USE; 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, observing that the tube will only fit into the socket in one orientation, as two of the pins are of larger diameter. Do not use excessive force. Replace the top glass cover before operating the amplifier.

A slight violet glow in the tube is not cause for concern. If at any time the plate (the outermost metal structure) of the output tubes begins to glow bright orange or red SWITCH OFF IMMEDIATELY. The red glow indicates that the tube is "running away", being destroyed by conducting excessive current. 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.
- 3) The tube is defective.

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

Switch off immediately if any part visible through vent slots at the back of the chassis glows orange. See Safety Notice at the front of this manual.

For further information, refer to Tips & Advice: Tubes in General and Tips & Advice: Output Tubes.

CHECKING OUTPUT TUBE CONDITION

As described at the beginning of this manual, the Phi 70 is equipped with the 300B Sentry circuit, which continuously monitors each output tube to ensure that it is operating within normal limits. Each tube has a corresponding indicator light on the front panel.

A green indicator light will be seen until the amplifier warms up, and when a tube's idle current is less than normal. It is safe to use your amplifier under these conditions, but the tube should be replaced at your convenience. The threshold between green and no illumination is not precise; do not be overly concerned if some positions take longer to extinguish. The condition of individual tubes may be checked with the built in meter.

By operating the test switches below the light, the meter will display the exact idle current in the tube. Be certain to stop the music before making the reading. Typically, the meter will indicate near the dot at the center of the scale. A lower indication will also be observed if your power voltage is low.

If a strong air current is blowing on the amplifier, it is possible that a tube within the normal current range will still display the green indicator light.

If a tube draws excessive current, the indicator light will turn red and the high voltage supply will shut down. This tube should be replaced before using the amplifier.

Please note that operating the amplifier without adequate ventilation will cause the red indicator lights to come on and the amplifier to shut off. Operating the amplifier on a thick carpet will cause this, and is not safe.

REPLACEMENT OF LOW LEVEL TUBES

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

Replacement tubes are available from VAC and other sources.

For further information, refer to Tips & Advice: A Word About Tubes in General and Tips & Advice: A Word About Low Level Tubes.

CARE OF CHASSIS

VAC chassis are machined aluminum for superior electromagnetic performance. The main chassis is finished in nickel plating, which is kept waxed to prevent oxidation, staining, or discoloration of the nickel. The power supply chassis is finished in durable textured gloss paint. Cleaning the units with a damp cloth WHILE THE AMP IS SWITCHED OFF AND UNPLUGGED should suffice. Do not get cleaning solutions onto or into the tube sockets. A light coat of wax should be applied periodically to the nickel surfaces, taking care that the amplifier is cool and unplugged.

TIPS & ADVICE SECTION

A Word About Tubes in General

It is true 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 6SN7 from different manufacturers will probably find that they may not even be 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 5 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 a tube should be replaced when its 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 5 years.

It is normal to see a slight violet glow in a power tube such as a 300B or EL34. However, a vivid violet indicates excess current flow through the tube and should be investigated.

VAC can test tubes for concerned customers.

Tips: Output Tubes

Your VAC Amplifier uses the 300B or 300A filamentary triode. It is strongly recommended that replacement tubes be purchased only from VAC. If, however, you want to customize the sound to your tastes, be aware that as with interconnects and speaker cables, each tube manufacturer's 300B tends to have a distinct sound, as well as its own reliability profile.

Tips: Low Level Tubes

The Voltage Amplifier/Phase Splitter and driver tubes in the Phi Seventy is the 6SN7 medium mu octal twin triode. Your amplifier is fitted with the current production VAC Tested 6SN7 from China, which we find superior to the NOS types we have tried. There are dozens of versions of this tube available in new old stock (NOS) from a variety of sources. It would be impossible to characterize them all.

Other equivalent type numbers are 5692, 13D2, B65, ECC32, QA2408, QB65, and CV1988.

Tubes V1 and V2 should be transconductance matched, and tubes V3 and V4 should be transconductance matched; this minimizes distortion.

We strongly recommend obtaining tubes as sets from VAC.

Tips: 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.

The available connections on your Phi Seventy are:

<u>Labeled</u>	<u>Use with speakers of</u>
8 ohms	4 to 8 ohms
4 ohms	2 to 4 ohms
2 ohms	1 to 2 ohms

Since the impedance of most loudspeakers vary over a wide range experimentation is essential. Most speakers have a rated impedance of 4 or 8 ohms. We recommend starting with the 8 ohm connection; after you know the sound of that connection, try the 4 ohm connection. Choose the connection that sounds best to your ears.

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.

Contrary to popular misconception, no power is lost due to unused output taps.

For more information consult VAC Technical Monograph 90-9.

Tips: Audio Grounding

Systems incorporating single-ended interconnect cables (“RCA cables”) are prone to a problem known as “ground looping”, which can result in extraneous hums and buzzes audible through the loudspeaker. If this occurs in your system, you have two options: 1) to work to minimize the ground loop, or 2) use the balanced input via the supplied adapter to break the ground loop.

To minimize the buzz using the normal RCA input jack, there are several steps you can take:

- 1) Use the shortest interconnects possible.
- 2) Use interconnects with good shielding properties.
- 3) Keep the two amplifiers and their cables as close together as possible.
- 4) Use the same AC outlet for both channels.
- 5) Keep the AC cords away from the audio cables.
- 6) Keep the power supply chassis away from audio chassis and audio cables.
- 7) Try different ground settings on your preamplifier, if it has them. For example, the VAC Signature, Phi, and Renaissance preamplifiers may be set to “ungrounded” or “XLR” audio modes.
- 8) The use of cheater plugs is not recommended and poses as safety hazard.

The simplest approach is to run the RCA cable into the balanced XLR jack via the supplied adapter. The balanced input is buffered by a wideband transformer, and effectively breaks ground loops in most systems.

SPECIFICATIONS

The VAC Phi Seventy 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 principals 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 when operated at 120 VAC, 60 Hz.

Power Output: 65 watts continuous average power at 1 kHz with less than 2% THD into 4 ohms connected to the 8 ohm tap.

Frequency Response: down 0.5 dB at 7 Hz and 30 kHz, ref 0 dB = 1 watt @ 1 kHz.
down 3.0 dB at 3.5 Hz and 115 kHz, ref 0 dB = 1 watt @ 1 kHz.

Absolute Polarity: Does not invert absolute phase.

FOOTNOTES:

1. Tube Manufacturing at Western Electric: The WE 300, Attila R. Balaton. Journal of the Audio Engineering Society, Vol.37, No.11, November 1989, pages 949-958.
2. The Low-Loading Self-Biased Amplifier, L.B.Dalzell. Audio, December 1959, pages 19-21.
3. The Fixed-Bias Story (Is Fixed Bias Really Better?), Herbert Ravenswood. Radio-Electronics, February 1958, pages 47-49.
4. Philips Hi Fi Amplifier Circuits. Published in Holland, 1958.
5. WE 300B. MJ Audio Technology, 1992/5, pages 213-215.

WARRANTY

Your equipment is warranted for a period of thirty (30) days from the date of purchase. In addition, if the registration form 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 (tubes excepted). This warranty applies only to units sold in the United States of America through authorized VAC dealers. It covers factory service and standard return shipping. 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. The dealer and/or customer are responsible for determining the suitability of this product for any specific application.

Your questions and comments are always welcome. Contact:

Valve Amplification Company
1731 Northgate Boulevard
Sarasota, FL 34234
Telephone (941) 359-2066 Fax (941) 359-2057
info@vac-amps.com

Detach and mail to the address above as soon as possible.

Phi Seventy Registration Form

Name _____

Address _____

Telephone _____ / _____ - _____ e-mail _____

Dealer name _____ City _____

Salesperson _____ Purchase date _____ Serial Number _____

How did you first learn of VAC products? _____

What other brands/models did you consider? _____

What made you decide on the VAC? _____

What else would you like us to know? _____

Optional:

What magazines do you read regularly? _____

What are your hobbies (besides filling in warranty cards)? _____

What are your favorite types of music? _____

On what format? (CD, LP, DVD, SACD, MP3, etc.) _____