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MODEL D-70 AMPLIFIER

OWNER'S MANUAL

SCHEMATIC AND PARTS LIST

6-1-83

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INTRODUCTION

Please take time to read this manual prior to use or installation of your D70 amplifier.

The D70 is a vacuum tube amplifier constructed to high commercial standards. It is also capable - within its power limits - of redefining the state-of-the-art of music reproduction. In order to achieve this, however, it is necessary that it be used synergistically with commensurate quality associated components. Just as a chain is not stronger than its weakest link, so it is in a music playback system. Attention to details such as the quality of interconnect cables, speaker wires, cartridge-arm interface and adjustments will reward you with satisfying results. It is also important that a preamplifier capable of unrestricted musical dynamics be used. Without these considerations you will no doubt hear a difference between this amplifier and others. However, the results may not be gratifying. The computer industry has a saying which is somewhat appropriate here: "Garbage in, Garbage out." Our analogy would be more like that of comparison of a very clean, clear window with one that is only translucent. If the scenery on the other side is pleasant, then the clean, clear window is preferred. So it is with the D70 amplifier. If you do not experience the definitive musical improvement available with this amplifier, a discussion of your system with your authorized Audio Research dealer or our Customer Service Department is suggested.

WARRANTY STATEMENT

A Linited 90-Day Warranty (from the date of purchase by the original purchaser; but must be within two (2) years of the date of manufacture) is provided by Audio Research Corporation. This includes vacuum tubes. This warranty is subject to the conditions and limitations stated within the documents attached to the outer shipping carton and is repeated in full on Pages 8 and 9 of this manual. Please read the following WARRANTY REGISTRATION CAUTION as well as the WARRANTY TERMS on Pages 8 and 9 of this manual to understand your responsibility as well as your rights regarding the warranties.

WARRANTY REGISTRATION CAUTION

It is your responsibility to register your unit. It is true that Audio Research Corporation will provide warranty service for 90 days even if you do not register your unit (proof of purchase, the photocopy of your bill of sale, will be required). However, we offer an extended Limited 3-Year Warranty simply for registration of the unit within 30 days from the date of your purchase. (Note that this extended warranty - if received - does NOT include vacuum tubes.)

Please note that it is not Audio Research's (or your dealer's) responsibility to insure this registration. It is yours, and yours alone. The warranty papers are attached to the carton. Do not delegate this responsibility to anyone else. You can know that your unit is registered only if you do it yourself and if you receive back from Audio Research a validated Warranty Certificate. Audio Research wants you to have the extended Limited 3-Year Warranty. However, the validated warranty will not be issued if the unit is not registered within 30 days of the date of purchase.

Take time now to read Paragraph 1 of the WARRANTY TERMS and WARRANTY EXTENSION TERMS on Pages 8 and 9 of this manual so that you will clearly understand what is required of you in order to accomplish the warranty registration.

USE CAUTIONS

1. Please be certain to read this manual over to familiarize yourself with your new amplifier before placing it in service.

2. Your D70 amplifier's power cord is equipped with a standard three-prong grounding plug which, if used normally, will ground the chassis to the power line. While this procedure undoubtedly provides the maximum possible safety in use, it will, in many cases, cause your audio system to have a residual hum.

It is usually best to keep the preamplifier "earth grounded" and "float" the grounds of power amplifiers and other equipment to eliminate ground loop hum. The audio interconnect cables then keep the power amplifiers at safe earth ground potential. If there is any question as to the safety of grounding procedures, be certain to seek competent help with the installation.

WARNINGS

1. To prevent fire or shock hazard, do not expose this equipment to rain or moisture.

2. This unit contains voltages which can be lethal. Do not operate this unit with its covers removed. Refer servicing to qualified personnel.

CAUTION

For continued protection against fire hazard, replace all fuses only with the same type and rating of fuse as specified.

PACKAGING

Save all packaging. Your Audio Research® amplifier is a precision electronic instrument and should be properly cartoned any time shipment is made. You may not have occasion to return it to the factory for service, but if that should prove necessary, or other occasion to ship it occurs, the original packaging may save your investment from unnecessary damage or delay.

REMEMBER: Remove all the vacuum tubes from their sockets and package them in the individual cartons to avoid damage in shipment. Mark each tube with its "V" number so that proper relocation can occur at re-installation.

ACCESSORIES INCLUDED WITH YOUR D70 AMPLIFIER

1 Phillips screw driver (for cover removal)
1 Plastic screwdriver (for internal adjustments)
Spare Fuses:
  1 - 5A MDS AC line fuse (3A MDA for 240V)
  1 - 1A 3AB Screen fuse (This is a 'fast-blow" fuse. It is extremely important that only this type and rating be used as the screen fuse.)

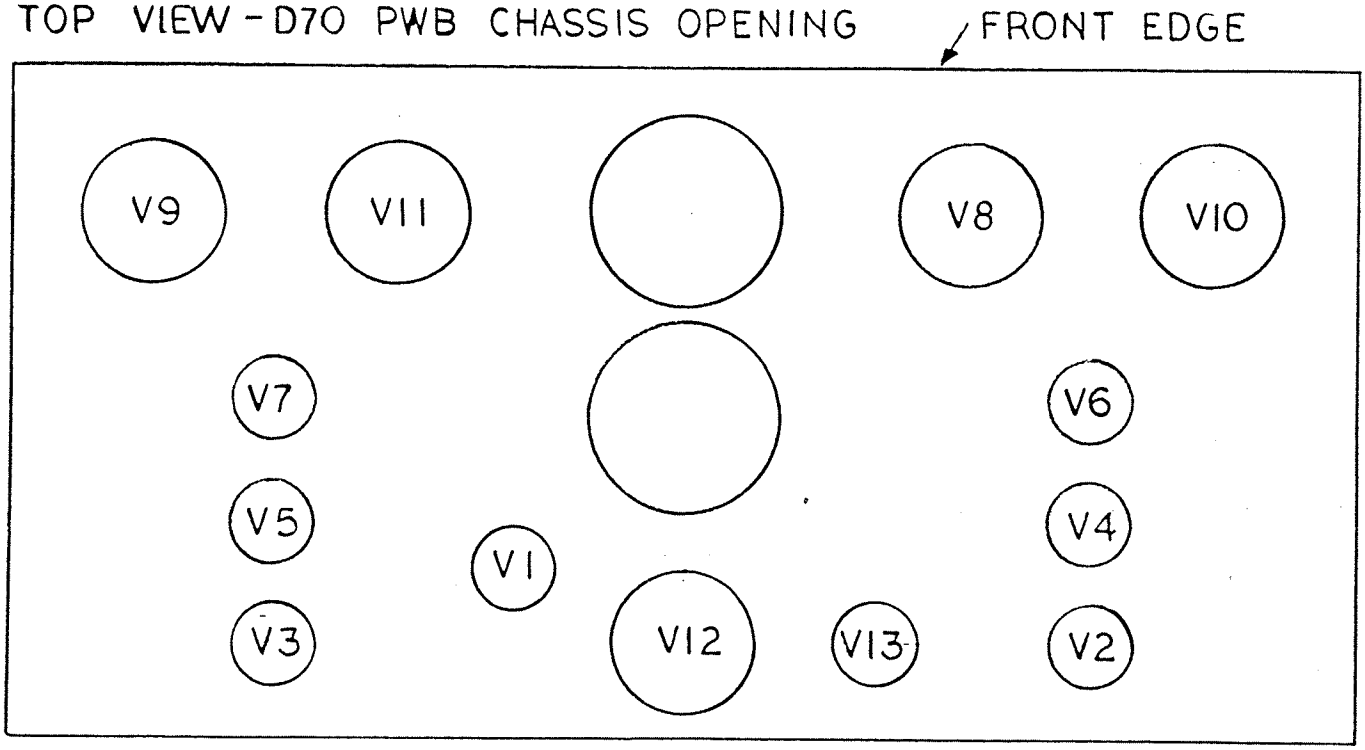
PREPARATION FOR USE

Your D70 amplifier is shipped with all of the vacuum tubes removed, packaged and wrapped so that they will not be broken or internally damaged in shipment. It is necessary to install these before using your amplifier. Proceed as follows:

1. Using the Phillips screwdriver provided, remove the top cover and temporarily set it and its screws aside.

2. Note that each vacuum tube, packaged separately under the cover, has its own box marked with a "V" number. Install these tubes carefully, observing the proper locations according to the chart below, and being careful to observe the "keyway" on the base of the 5 large power tubes. Be certain the tubes are properly aligned with the matching keyway in the tube socket and install them firmly without forcing or undue side-to-side "wiggling." Observe also that the small tubes have 9 pins with a space where a 10th pin might have been located. The sockets are spaced this way also. Take care not to mis-align and thereby possibly bend the tube pins or injure the socket while inserting them.

TOP VIEW - D70 PWB CHASSIS OPENING



3. Reinstall the cover. You may now proceed with INSTALLATION and OPERATING INSTRUCTIONS.

INSTALLATION

To insure normal component life and safe operation this unit must be operated only in a horizontal position. Adequate air flow and proper cooling thereby can occur only if there is no restriction below, behind and above the unit.

The five (5) special non-marring elastomer feet provide adequate spacing only from a smooth, hard surface. Never operate the unit while it is sitting on a surface such as a rug or carpet.

If the unit is to be operated in an enclosure such as an equipment rack, make certain that adequate air flow above and below the unit is provided. The "ambient" operating temperature should never exceed 120°F or 50°C. Use the Audio Research Corporation Rack Mount Ventilators (RMV-3) above and below each unit.

It is normal for a vacuum tube power amplifier to run "warm," and if used for prolonged periods, "hot" to the touch. All components within are, however, operated at safe, conservative levels and will not be improperly affected thereby, providing the requirements outlined above are adhered to.

CONNECTION INSTRUCTIONS

The front panel has:

1 Switch - AC power on-off
2 Fuse Holders - 1 power line, 1 screen
2 Indicators - 1 power line on, 1 screen power on (these indicators also serve as fuse-out indicators)

The rear panel has:

2 Input Connectors
2 Terminal Connector Barrier Blocks
1 Power Line Cord

To place the unit in operation the following procedure is recommended:

1. Connect your speakers using the best available speaker wires. We cannot emphasize this enough. It has been determined that the better the component system the more important it becomes to use the very best interconnect and speaker wires.

Note that the D70 is a "non-inverting" amplifier. It is important, sonically, that your entire system be connected so that the audio signal arriving at the speaker be "non-inverting."

2. Wire the left speaker "0" or "-" connection to the left "0" amplifier terminal. Wire the speaker "+" or otherwise identified (such as "4," "8," "16" "Hot") positive terminal to the "4," "8" or "16" ohm amplifier terminal as required. Repeat this precedure with the right speaker and amplifier right channel connections.

NOTE: It is important to use as close as possible an impedance match between amplifier and speaker so as to allow optimum transfer of power to the speaker while preserving minimum distortion operation of the amplifier. In the case of some complex speaker systems, including electrostatic types, the best impedance match should be determined empirically.

3. CAUTION: The outputs of your D70 amplifier, like all ARC tube amplifiers, are "balanced" outputs. This is so because of the nature of our partially cathode-coupled output stage and overall balanced design. Since the output terminations are marked in "impedance" (ie: "4," "8" and "16" ohms), and since the center taps of the output windings must be gounded:

$$\frac{\sqrt{Z1}}{\sqrt{Z2}} = \frac{T1}{T2} \qquad \frac{\sqrt{4}}{\sqrt{16}} = \frac{2}{4}$$

the "4" ohm taps are grounded, being the center tap. This is unimportant is actual use except to be aware of the following possible situations:

a) Headphone speaker switching devices. Many of these units have a "common ground." This, of course, will connect the two amplifier "0" terminals together. Since the "4" ohm terminals are already connected together internally (remember, they are the common grounded center tap) you now have strapped the two amplifier sections together and created a modified monaural amplifier. Inevitably, these headphone speaker switching devices are also not satisfactory sonically in systems of a quality justifying the use of a D70 amplifier. Our best recommendation is not to use them at all. If one "must" be used, contact Customer Service at ARC for instructions.

b) Some complex loudspeaker systems with integral power supply/crossover networks can have a common ground system, possibly also with grounding through the power line, just as the D70 amplifier does. If a "ground lifter" is not used, the result is that the amplifier is called upon to drive a virtual short circuit in addition to the problem listed in a) above. If your speaker system employs a power line connected power supply/crossover network and you experience either "monaural" sound and/or extremely weak and distorted sound, contact Customer Service or Engineering at ARC for instructions concerning your specific speaker.

4. Connect the amplifier to the preamplifier or electronic crossover, using only the highest grade audio interconnect cables.

5. Place the power on-off switch in the "off" position and connect the power line cord to the AC power, observing Paragraph 2 under USE CAUTIONS, Page 2 of this manual.

CAUTION: Make certain the amplifier is installed according to the instructions under INSTALLATION on Page 4 of this manual. Contact your dealer for help if you have any questions on the above procedure.

OPERATING INSTRUCTIONS

1. Make sure that you have complied with the INSTALLATION and CONNECTION INSTRUCTIONS prior to attempting operation.

2. The preamplifier should initially be muted or at minimum gain since the D70 does not employ input level controls.

3. Turn the D70 power switch "on." You will note a short delay of approximately 1/2 second before the power relay clicks in and the "on" (and fuse out) indicator lamp reaches full brilliance. This "soft start" protection is provided to minimize the power surge of charging the D70 capacitors, to prolong component life and eliminate the momentary "light dimming" often encountered when switching on audio power amplifiers. The duration of this turn-on delay will vary with line voltage.

4. After about 10-30 seconds the "screen" lamp will also light, indicating that the high voltage regulators have reached operating temperature.

5. The D70 will now operate satisfactorily. However, a full stabilization time of one-half hour or more is recommended for best sonic performance.

ADJUSTMENT PROCEDURE AND DISCUSSION

The D70 utilizes very high quality, commercial and computer grade components and this, together with conservative operation of all components and tubes, will provide long service life, if installed and operated within the parameters outlined in this manual.

After long service, or after vacuum tube failure and replacement, or in a location with consistently low line voltage, it may be desirable to readjust the amplifier for optimum performance.

CAUTION: The following internal procedures should not be attempted by the owner unless he is technically qualified. There are high voltages and currents within this unit which can be lethal under certain conditions. All internal adjustments should be accomplished by a qualified individual.

There are three (3) parameters which may be adjusted (in the following sequence) in the D70. These adjustments are internal, requiring removal of the top cover. Use the plastic alignment tool provided.

1. OUTPUT TUBE IDLE CURRENT ("BIAS")
2. DC BALANCE
3. AC BALANCE

1. OUTPUT TUBE IDLE CURRENT ("BIAS")

The output stages of the D70 are partially cathode-coupled "push-pull Class AB_1," utilizing our tightly-coupled output transformers which provide low distortion and sonic accuracy.

As shipped from the factory, the output "bias" adjustments are set for a nominal 65mA. per tube with a stable power line voltage of 120. (Export models are adjusted for each country's requirements.) Under these conditions the tubes are each dissipating approximately 28 watts of their 48 watt rating (42 watt plate, 6 watt screen). This point of operation provides "enriched" Class AB_1, and will satisfy most critical listeners.

Although the main "B+" voltage to the output tubes will vary with line voltage, the "bias" voltage and the "screen" voltage are electronically regulated. Because of this, the change in operating point of the output stage does not vary significantly with minor changes in line voltage. It is therefore not normally necessary to readjust "bias" unless line voltage is consistently abnormally low or when changing power output tubes.

Make sure that ventilation requirements are met as described under INSTALLATION to prolong tube and other component life.

1A. "BIAS" ADJUSTMENT PROCEDURE

For best results operate and adjust the D70 at 120VAC line voltage, or at the line voltage that is typical in the final installation. Adjustments should be made under zero-signal conditions after at least 15-20 minutes of uninterrupted stabilization time. There may be a very slight interaction between the 4 output tube bias adjustments, so recheck the first tube current after adjusting the other three, etc., until you are certain that all are correct and stabilized.

A digital voltmeter capable of accurate measurement of .05 to .1 Volt DC is required to accomplish this adjustment. Use the plastic alignment tool provided to make the adjustments.

There is a 1 ohm 5% wirewound resistor in the cathode circuit of each output tube, and test connections (test points referred to schematically and on the circuit board as TPs) are provided at either end of these resistors so that a voltage measurement can be conveniently made across each resistor. These test points are identified and accessible from the top side of the circuit board.

Because the resistor is 1 ohm, you can conveniently "direct" read the total cathode current in each tube. A .065 Volt reading indicates 65mA.

	TUBE	TEST POINTS	ADJUSTMENT
Channel 1	V8	TP1, TP3	RV"7" ("RV" is not indicated
	V10	TP5, TP7	RV"9" on the circuit board.)
Channel 2	V9	TP2, TP4	RV"8"
	V11	TP6, TP8	RV"10"

It is important that all 4 output tubes be reasonably matched (within 5%) for highest performance operation. (Matched sets are available from Audio Research.) It is also important, both for long life free from arcing effects as well as sonically, that these tubes be of a low "gas" nature. Tubes provided by Audio Reasearch will meet these parameters.

2. DC BALANCE

The D70 uses an improved version of our patented cross-coupled input/driver circuit that automatically tracks normal minor tube drift. Therefore, the accuracy of DC balance required for best performance is not super-critical. However, it is necessary to check and reset DC balance if input tubes V2 or V3 are changed.

A battery-operated digital voltmeter having a 10 megohm or higher input impedance and 3½ digit resolution or better is needed for this adjustment.

Set each adjustment for +105V DC within 0.1V of equal voltages for the two test points of each channel. Allow at least 20-30 minutes warmup stabilization for best results, plus 10-20 hours "burn-in" for the new tubes.

The sonic or measured degradation is minimal with up to 2 volts of DC unbalance, but it is best to set the balance within 0.1V to allow for tube aging.

	TUBE	TEST POINT	ADJUSTMENT	SET TO	
Channel 1	V2	TP9 TP11	RV1 RV3	+105V DC) +105V DC)	0.1V Matched
Channel 2	V3	TP10 TP12	RV2 RV4	+105V DC) +105V DC)	0.1V Matched

If proper voltages cannot be achieved, replace the tube indicated above.

3. AC BALANCE

Normally the AC balance does not require readjustment. If any tubes are changed, you may want to recheck its setting. However, this adjustment should not be attempted unless low distortion measuring equipment is available.

First, make sure the output tubes are properly biased and that the DC balance is correct.

Using the plastic alignment tool provided, set RV5 and RV6 for minimum second harmonic distortion at 1 to 2 watts of 1kHz output into a 16 ohm load, typically less than .001%. As an approximation, the adjustments can be made for minimum 1kHz total harmonic distortion and noise, typically less than .02%.

A properly adjusted unit will achieve AC balance at about midrotation $\pm 30^{o}$ of RV5 and RV6. If lowest distortion requires adjusting beyond this range, it may indicate a weak or unbalanced tube at V6 or V7, or possibly other tubes.

WARRANTY TERMS

This unit is offered for sale with a LIMITED Warranty as set forth below:

1. Warranty. Audio Research warrants the product designated herein to be free of manufacturing defects in material and workmanship, subject to the conditions set forth herein, for a period of 90 days from the date of purchase by the original purchaser, provided it is purchased within two (2) years of the date of manufacture of the unit.

To obtain this warranty, proof of purchase (photocopy of bill of sale by an authorized Audio Research dealer) must be submitted with the unit for any repairs under the terms and conditions herein set forth.

2. Conditions. This Warranty is subject to the following conditions and limitations. The Warranty is void and inapplicable if the product has been used or handled other than in accordance with the instructions in the owner's manual, abused or misused, damaged by accident or neglect or in being transported, or the defect is due to the product being repaired or tampered with by anyone other than Audio Research or an authorized Audio Research repair center. The product must be packed and returned to Audio Research or an authorized Audio Research repair center by the customer at his or her sole expense. A RETURNED PRODUCT MUST BE ACCOMPANIED BY A WRITTEN DESCRIPTION OF THE DEFECT AND A PHOTOCOPY OF THE BILL OF SALE. Audio Research reserves the right to modify the design of any product without obligation ot purchasers or previously manufactured products and to change the prices or specifications of product without notice or obligation to any person.

3. Remedy. In the event the above product fails to meet the above Warranty and the above conditions have been met, the purchaser's sole remedy shall be to return the product to Audio Research or an authorized Audio Research repair center where the defect will be rectified without charge for parts or labor, except vacuum tubes (see 6 below).

4. Limited to Original Purchaser. This Warranty is for the sole benefit of the original purchaser of the covered product and shall not be transferred to a subsequent purchaser of the product.

5. Duration of Warranty. This Warranty is for a period of 90-days from date of purchase from an authorized Audio Research dealer.

6. Vacuum Tubes. Vacuum tubes and replacement thereof are also warranted for the 90-day period.

7. Miscellaneous. ANY IMPLIED WARRANTIES RELATING TO THE ABOVE PRODUCT SHALL BE LIMITED TO THE DURATION OF THIS WARRANTY. THE WARRANTY DOES NOT EXTEND TO ANY INCIDENTAL OR CONSEQUENTIAL COSTS OR DAMAGES TO THE PURCHASER. Some states do not allow limitations on how long an implied warranty lasts or an exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

WARRANTY EXTENSION TERMS

Because Audio Research wants each unit to be "registered" at the factory for various reasons, an extension of the Limited Warranty to 3-years from date of purchase (by the original purchaser and provided it is purchased within two (2) years of the date of manufacture of the unit) is offered in exchange for registration of your unit. Appropriate forms are attached to each product carton to accomplish this. Please note the following in regard to this:

1. Registration must be postmarked within 30 days from the date of purchase from an authorized Audio Research dealer. Exceptions to this will not be made.

2. Vacuum tubes are NOT included in this warranty extension offer.

3. All other terms and conditions as set forth in the WARRANTY TERMS apply.

4. Please read the WARRANTY REGISTRATION CAUTION as set forth on Page 1 of this manual.

D70 SPECIFICATIONS (AC line set @120V 60Hz for these specifications)

Power Output:
65 watts per channel minimum continuous (both channels operating) at 16 ohms from 20Hz to 20kHz with less than 0.5% total harmonic distortion (typically below .005% at 1 watt)

Approximate actual power available per channel at "clipping") both CH. OP, 1kHz): 70 Watts
(Note that actual RMS power output is dependent upon both line voltage and "condition" ie: if power line has high distortion, maximum power will be affected adversely, although from a listening standpoint this is not very critical.)

Power Bandwidth:
(-3dB Points) 10Hz to 60kHz

Intermodulation Distortion:
Less than .1% at 1dB below rated output (80V p to p, 16 ohms - SMPTE method)

Input Sensitivity:
.95V RMS for rated output

Input Impedance:
75K ohms, nominal

Output Regulation:
Approximately .4dB, 16 ohm load to open circuit
(Damping factor approximately 20)

Negative Feedback:
22.2dB

Slew Rate:
12 volts/microsecond

Rise Time:
3 microseconds

Hum & Noise:
Better than 90dB below rated output (Broad-bandwidth unweighted, inputs shorted)

Power Supply Energy Storage:
Approximately 150 joules

Power Requirements:
105-125 VAC 60Hz (210-250VAC 50Hz) 600 watts maximum
240 watts at "idle"

Dimensions:
19" (48 cm) W (standard rack panel) x 7" (18 cm) H x 14.5" (37 cm) D (front panel back). Handles extend 1 5/8" (4.1 cm) forward of the front panel.

Weight:
49 lbs. (22.3 kg) Net; 64 lbs. (29.1 kg) Shipping

Tubes Required:

2 - Matched Pair 6550 (low gas)	Power Output
1 - 6550 (low gas)	Regulator
1 - 12AX7	Regulator Driver
7 - 6DJ8 (ECC88)	Small Signal