Price: $5.00

MODEL D-160 POWER AMPLIFIER

OWNER'S MANUAL

2-15-82

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INTRODUCTION

Congratulations on your purchase. The D160 amplifier was conceived in response to the need for a totally "musical" amplifier with state-of-the-art power bandwidth and accuracy.

Accurately balanced circuitry throughout, together with other innovations and high energy, well regulated power supplies, provide a significantly wider musical bandwidth together with ARC's traditional High Definition® music reproduction.

Heavy two-sided, plated through-hole circuit boards are used with all components readily accessible for replacement if ever necessary with only cover removal.

Push-pull-parallel output tubes are used at approximately 75% of their dissipation ratings, with forced air cooling to insure long service life.

The D160 incorporates a number of significant innovations and features, including: four electronically-regulated power supplies, LED instantaneous power indicators, simplified bias adjustment and low-surge startup circuit.

With proper installation and reasonable maintenance, this amplifier should satisfy your musical reproduction requirements for as many years as you care to use it.

WARRANTY STATEMENT

A Limited 90-Day Warranty (from date of purchase by the original purchaser; must be within 2 years of 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 Page 9 of this manual.

WARRANTY REGISTRATION CAUTION

It is your responsibility to register your unit. While it is true that Audio Research Corporation will provide warranty service for 90 days even if you do not (proof of purchase, such as a photocopy of your bill of sale, will be required), you will lose the extended Limited 3-Year Warranty unless you register the unit within 30 days of the date of your purchase. Be sure to read our warranty statement for complete information about this. (Note that this extended warranty does NOT include vacuum tubes.)

It is also important to register your unit so that Audio Research Corporation can contact you, if the need arises, for any possible modification news, etc.

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 D160 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.

   The best way to prevent this hum, especially noticeable in bi- or multi-amplified systems, or in rack-mount installation with common mounting of multiple components, is to "float" this ground (as well as the ground of any and all other conponents). (ARC manufactures all its products so that there is no direct chassis connection to the power line except for the line cord's grounding wire. This is to say that all of our units have a power transformer which isolates the power line from all active circuitry. The only current that can flow between the chassis and some other line potential is the leakage of the transformer. Under any normal use applications this does not present any hazardous shock potential.) However, if there is any question as to the safety of such a procedure, be certain to seek competent help with the installation.

   And, of course:

   WARNING

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

   B. 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 same type and rating of fuses supplied and specified at each fuse holder.

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.

ACCESSORIES INCLUDED WITH YOUR D160 AMPLIFIER

Spare Fuses: 2 - 10A MDL Slo-Blo AC line fuses (5A MDX Slo-Blo for 220-240V).
2 - 1/2A AGC normal-blow screen fuses
1 - Phillips screwdriver
1 - Plastic alignment tool

PREPARATION FOR USE

Your D160 is shipped with the output vacuum tubes removed for protection, individually boxed and labelled. Remove the protective top cover using the Phillips screwdriver supplied, and carefully install each tube in the corresponding socket as marked on the circuit board. Replace the cover.

INSTALLATION

To insure normal component life and safe operation, this unit must be operated only in a horizontal position.

The 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 because airflow will be restricted and will be inadequate for proper cooling.

If the unit is to be operated in an enclosure such as an equipment rack, make certain that adequate airflow above and below the unit is provided. The "ambient" operating temperature should never exceed 120°F or 50°C. Audio Research manufactures a "Rack Mount Ventilator" (RMV-3). The use of these in rack mount installations will assure proper ventilation.

It is normal for a vacuum tube power amplifier to run "warm" or "hot" to the touch. All components within are, however, operated at safe, conservative levels and will not be adversely affected thereby.

D160 CONNECTION INSTRUCTIONS

The front panel has:

1 - On-off power switch and LED indicator
2 - Fuses and fuse-out indicator lamps
2 - LED instantaneous power indicator arrays

The rear panel has:

2 - Gold-plated input connectors
2 - Input level control knobs
2 - Output connection terminal barrier blocks
1 - Line power cord
1 - Bias test switch
2 - Banana bias test jacks

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

1. Connect your speakers using the best available heavy gage speaker wires. Take care to observe "polarity" (ie: 4, 8 or 16 ohms to speaker "+"; "0" ohms to speaker "-"). (Note that the D160 is a "non-inverting" amplifier when connected in this manner.)

   Note: It is important to match impedances as closely as possible between amplifier and speaker so as to allow optimum transfer of power to the speaker while preserving minimum distortion operation of the amplifier.

2. Turn both input level controls fully counter-clockwise.

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

4. Connect the power line cord to the AC power, observing Paragraph 2 under USE CAUTIONS on Page 2 of this manual.

5. Proper adjustment of the input level controls can be accomplished very simply. Turn your preamplifier level control to 12 to 1 o'clock while playing a record. Then, advance (from the previously counter-clockwise settings) the amplifier level controls to your normal listening level. This provides optimum "bandspread" of adjustment at the preamplifier, as well as providing optimum signal-to-noise ratio. (The D160 will normally perform best sonically with its level controls at or near maximum.)

   CAUTION

   Make certain the amplifier is installed according to the instructions under INSTALLATION on Page 3 of this manual.

D160 ADJUSTMENT PROCEDURE AND DISCUSSION

The D160 utilizes very high quality commercial grade components and this, together with conservative operation of all components and tubes, should provide long adjustment-free service life.

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 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. Refer all such adjustment to a qualified individual.

There are eight parameters in the D160 which may be adjusted in the following sequence. However, only the output tube bias and AC balance adjustments are likely to need checking as tubes age. All other adjustments are essentially permanent, except in the event of component failure.

1. BIAS REGULATOR VOLTAGE
2. SCREEN REGULATOR VOLTAGE
3. DRIVER B+ REGULATOR VOLTAGE
4. INPUT B+ REGULATOR VOLTAGE
5. OUTPUT TUBE IDLE CURRENT ("BIAS")
6. DC BALANCE (INPUT DIRECT COUPLED STAGE)
7. AC BALANCE (DRIVER)
8. LEVEL INDICATOR SENSITIVITY

The output tube bias adjustments, test switching and test points are accessible at the rear of the unit without removing the covers. In many cases a simple "tune-up" may be accomplished with only the output tube bias adjustments. USE THE PLASTIC ADJUSTMENT TOOL PROVIDED WITH THE UNIT TO AVOID CONTACT WITH DANGEROUS VOLTAGES. Other adjustments require removal of top or bottom covers, and should not be attempted by other than a qualified technician.

1. BIAS REGULATOR VOLTAGE

This adjustment is located on top of the output tube board, just behind regulator tube V16. Connect a voltmeter to the negative (lower) end of the 50uF 150V electrolytic capacitor at the far right rear of the unit (on the vertically mounted PWB) and measure to chassis. Adjust RV18 for -48 VDC at this test point.

CAUTION: If there is any question of malfunction of the bias supply, perform tests and adjustments with the front screen fuse removed. This will prevent any damage from excessive output tube current. REMEMBER THAT WITH NO LOAD ON THE +600V SUPPLY, IT MAY STORE LETHAL ENERGY FOR UP TO 30 MINUTES OR MORE.

For safety after turning the D160 off, discharge the +600V supply with a 1000 to 2000 ohm 10W resistor to chassis. This voltage is accessible at the rear of 270K 2W resistor R59 at the right of the large capacitor bank.

Replace the screen fuse after the voltage has discharged. This fuse (F2) supplies current to all 3 high-voltage regulators.

2. SCREEN REGULATOR VOLTAGE

This adjustment is located on top of the unit next to output tube V11. Connect a voltmeter to the rear of the 270K 1W resistor R70 at the left of the large capacitor bank, and measure to chassis. Adjust RV17 for +350VDC at this test point. (Be certain not to connect to the wrong end of R70 which has only a nominal 90 volts and bears no relation to the +350 volt adjustment.)

CAUTION: If there is any question of malfunction of the bias or screen supplies, or if the output tube bias adjustments are not close to their proper settings, remove all 8 output tubes V7-14 before making adjustments or tests. This will prevent any damage from excessive output tube current. (Mark output tubes with V numbers so they may be returned to their original positions.)

3. DRIVER B+ REGULATOR VOLTAGE

This adjustment is located at the rear of the unit just below regulator tube V17. Connect a voltmeter to the top of the 1000pF styrene capacitor C65 below V17, and measure to chassis. Adjust RV19 for +450VDC at this test point.

4. INPUT B+ REGULATOR VOLTAGE

This adjustment is located at the rear of the unit just below regulator tube V18. Connect a voltmeter to the top of the 1000pF styrene capacitor C66 below V18, and measure to chassis. Adjust RV20 for +325VDC at this test point.

5. OUTPUT TUBE IDLE CURRENT ("BIAS")

The output stages of the D160 are partially cathode-coupled "push-pull-parallel" class AB_1, utilizing our tightly-coupled output transformers, which provide low distortion and sonic accuracy. It is important to maintain proper output tube idle current to insure proper sonic results.

As shipped from the factory, the output tube bias adjustments are set for a nominal 65 mA. per tube with a stable AC line voltage of 120 Volts from a low-impedance "solid" power source. Under these conditions the tubes are dissipating approximately 39 watts of their 50 watt rating (44 watt plate and 6 watt screen). This point of operation provides optimum "enriched" class AB_1 performance. Operation at higher currents will shorten tube life.

5A. "BIAS" ADJUSTMENT PROCEDURE

Connect a digital voltmeter capable of .001 volt DC resolution at +.050VDC to the "bias test" jacks at the rear of the unit. Select the desired tube with the "bias test" switch, and set the corresponding adjustment as indicated by V numbers on the back of the top cover. Measurement is across one ohm cathode resistors, so a +.065 VDC reading indicates the proper 65 mA. cathode current for each tube. The proper adjustment is near the clockwise end of each pot. Observe the following:

1. It is important that all 8 output tubes be reasonably matched (within 5%) for highest performance. If the cathode current for any tube has changed significantly compared to the others, check tubes before proceeding with bias adjustments. (Matched sets are available from Audio Research.)

2. These adjustments should be accomplished under no signal conditions with line voltage at its "normal" for the intended location. If this is not known, adjust line voltage for +610 VDC at the rear of 270K 2W resistor R59 at the right of the large capacitor bank, measure to chassis. Maintain this voltage during bias adjustments.

3. The D160 should be thoroughly "warmed up" (thermal equilibrium) prior to adjustment (typically 2 hours).

4. Move each adjustment slowly, allowing time for voltage stabilization as you make your reading. Line voltage instability will cause fluctuating cathode current readings.

6. DC BALANCE (INPUT DIRECT COUPLED STAGE)

Because of the nature of the push-pull direct couple input circuit, the bias of the driver stage following is determined by the DC balance of the input stage. Best sonic operation occurs when these DC voltages are the same within 0.05 VDC or better. The actual voltage is not critical at +105V $\pm$5 VDC. It is the balance within each channel that is important.

6A. DC BALANCE ADJUSTMENT

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

RV3 and RV5 adjust the left channel (TP1 and TP3)
RV4 and RV6 adjust the right channel (TP2 and TP4)

RV3 is located above V5, and TP1 is the inside end of the upper 47K 2W resistor by V3.

RV5 is located above V3, and TP3 is the outside end of the lower 47K 2W resistor by V3.

RV4 is located above V6, and TP2 is the outside end of the upper 47K 2W resistor by V4.

RV6 is located above V4, and TP4 is the inside end of the lower 47K 2W resistor by V4.

Adjust RV3 and RV5 to achieve identical voltages at TP1 and TP3. Allow time for the servo to settle to its final voltage. There is some interaction between adjustments because of the nature of the circuit. Make final trim adjustment for as close to 0 DVC difference between TP1 and TP3 with the DVM connected between TP1 and TP3.

Repeat the above using RV4 and RV6 to achieve identical voltages at TP2 and TP4.

It is not required that the left channel voltages be exactly equal to the right channel voltages. It is important that each channel's two TP voltages match and that they be within the range of 100 to 110 Volts DC.

It should not be necessary (except in the event of component failure) to readjust DC balance once it is set. The servo balance circuits compensate for tube aging, tube changing and line voltage variations.

7. AC BALANCE (DRIVER)

Normally the AC balance does not require readjustment unless the output or driver tubes are changed. This adjustment should not be attempted unless the previous adjustments are checked first.

Adjust RV7 and RV8 for minimum 2nd harmonic distortion at about 2 watts 1 kHz output into a 16 ohm load, typically less than .003%. As an approximation, the adjustments can be made for minimum 1 kHz total harmonic distortion and noise, typically less than .03%.

RV7 is located under V5, and RV8 is located under V6.

8. LEVEL INDICATOR SENSITIVITY

These adjustments are located below the chassis (remove bottom cover) just behind the corresponding LED peak power indicator arrays. Adjust each for the right hand "160W" red LED to just achieve full brilliance with 160W (50.6V RMS) into a 16 ohm load at 1kHz. (Balanced 25.3V RMS each side to chassis.) Make sure the line voltage is sufficient so that the output waveform is not clipping.

D160 FEATURES

1. Direct coupled push-pull input driver circuitry "servo" coupled with "IC" error correction for long term stability and minimum dynamic distortion.
2. Individual initial bias adjustments for all 8 output tubes.
3. Power supplies for input circuitry, driver circuitry, screen and bias are all individually, electronically regulated.
4. On-off switch (with low-surge start relay circuit).
5. Front panel line and screen fuses with "out" indicators.
6. Meter jacks and switch on rear chassis for easy output tube bias adjustment.
7. True "instantaneous" peak power LED readout.
8. Turn-on surge controlled by thermistor.
9. Built-in fans.
10. Input level controls (rear chassis).

WARRANTY TERMS

This unit is offered with a limited warranty as follows:

1. Warranty. Audio Research warrants the product designated herein to be free of manufacturing defects in material and workmanship, subject to conditions hereinafter set forth, for a period of three (3) years from the date of purchase by the original purchaser. To obtain this Warranty, THE ORIGINAL PURCHASER MUST MAIL TO AUDIO RESEARCH WITHIN THIRTY (30) DAYS OF THE DATE OF PURCHASE THE WARRANTY REGISTRATION FORM TOGETHER WITH A COPY OF THE BILL OF SALE OR OTHER PROOF OF PURCHASE OF THE PRODUCT. Audio Research will then validate the Warranty and return the validated Warranty to the purchaser.

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 VALIDATED WARRANTY. Audio Research reserves the right to modify the design of any product without obligation to purchasers of previously manufactured products and to change the prices or specifications of any 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 expires on the third anniversary of the date of purchase. During the first ninety (90) day period following the date of purchase by the original purchaser, the Audio Research Limited 90-Day Warranty supersedes this Warranty.

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

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.

D160 SPECIFICATIONS (AC line set @120V 60Hz for these specifications)

Power Output:
160 watts per channel minimum continuous (both channels operating) at 16 ohms from 25Hz 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): 200 Watts

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

Intermodulation Distortion:
Less than .5% at 1dB below rated output (136V p to p, 16 ohms) (SMPTE method)

Input Sensitivity:
1.2V RMS for rated output (adjustable)

Input Impedance:
75K ohms, nominal at maximum gain

Output Regulation:
Approximately .5dB, 16 ohm load to open circuit (Damping factor approximately 20)

Negative Feedback:
18.5dB

Slew Rate:
15 volts/microsecond

Rise Time:
5 microseconds

Hum & Noise:
Better than 90dB below rated output 20kHz bandwidth unweighted

Power Supply Energy Storage:
500 joules

Power Requirements;
105-125VAC 60Hz (210-250VAC 50Hz) 1500 watts maximum
500 watts at "idle"
800 watts at rated power

Dimensions:
19" (48 cm) W (standard rack panel) x 10 1/2" (26.7 cm) H x 21 3/8" (54.3 cm) D (front panel back). Handles extend 1 5/8" (4.1 cm) forward of the front panel.

Weight:
120 lbs. (55 kg) Net; 135 lbs. (62 kg) Shipping