Model 400

AMPLIFIER

Phase Linear

OWNER'S MANUAL

Model 400

AMPLIFIER

CONTENTS

The Phase Linear 400 is covered under Patent Number 3,727,148.

Phase Linear

20121 - 48th Avenue West, LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

Congratulations! You have purchased the most advanced amplifier that today's technology can produce.

A new generation of extremely fast, high energy silicon output transistors, and a host of new materials and techniques only dreamed of a short time ago has made possible an amplifier with performance characteristics that extend virtually beyond the limits of measurability. At 20 cycles per second, damping exceeds one thousand. Distortion is so low that it must be measured with only the finest laboratory equipment. Continuous power levels with a minimum of 201 watts R.M.S. per channel can be delivered into 8 ohms from 20 cycles per second to beyond 20,000 cycles per second.

Before leaving our factory your Phase Linear 400 was tested and certified to be in perfect operating condition. This manual has been prepared to help you operate your Phase Linear as well as keep it in perfect condition. Your Phase Linear, with proper care, is capable of providing a lifetime of musical fulfillment.

IMPORTANT: Phase Linear amplifiers are designed to protect the time and monetary investment you have in your stereo system. To achieve this the Phase Linear 400 has numerous protection circuits the simplest of which is its fusing. If the amplifier detects any irregularities it will blow fuses which protects both the amplifier and the load. The fuses must be replaced or the amplifier will:

1. distort badly
2. produce very little sound or no sound whatsoever

SHOULD THE AMPLIFIER MALFUNCTION IN ANY MANNER, REPLACE ITS FUSES. 99% of all problems with the Phase Linear 400 can be solved by replacing the fuses.

In addition, Phase Linear recommends fusing all speakers in order to provide them with the maximum protection.

All warranty service must be performed at a warranty service station located in the country where the unit was purchased or at the Phase Linear factory in Lynnwood, Washington U.S.A.

If you have any questions concerning the warranty please write to:

Service Manager, Phase Linear Corporation
20121-48th Ave. W., Lynnwood, Washington 98036

WARNING: TO PREVENT FIRE OR SHOCK HAZARD DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

PREPARATION OF PHASE LINEAR 400

PREAMP CONNECTION

To connect the Phase Linear 400 to a preamplifier use shielded audio cable from the outputs on your preamp to the RCA phono inputs on your Model 400 as shown in figure 1.

SPEAKER CONNECTION

Figure 2 illustrates the correct method of connecting the Phase Linear 400 to one pair of speakers. Heavy duty A.C. line cord of 18 gauge wire is recommended for the speaker connection. Make sure all connections are made properly. Dual banana plugs are recommended to minimize the chance of shorted output leads. **CAUTION:** Never connect the loudspeaker terminals of one channel in parallel with those of any other. Extra caution should be taken to insure that no stray speaker wires are touching any other wire or terminal since a short circuit may occur.

PHASING

Correct phasing must be made when connecting the amplifier to the speakers. If the polarities of the speakers and the amplifier are not matched correctly, sound cancellations will occur at some frequencies. Proper phasing can be assured by making sure the common leads of the amplifier run to the common leads of the speakers. The positive leads to the speakers must correspondingly run to the positive leads of the amplifier.

SPEAKER IMPEDANCE

Phase Linear does not recommend the operation of the amplifier below a 4 ohm impedance. NOTE: For simultaneous operation of more than one pair of 4 ohm loudspeakers see diagram on series wiring, Figure 3. We recommend series wiring for all multiple speaker hookups. Please contact your dealer for any specific problems with speaker installation you may have.

CHASSIS GROUND

The chassis is grounded to the speaker terminal and no further grounds are required.

A.C. MAIN POWER SUPPLY

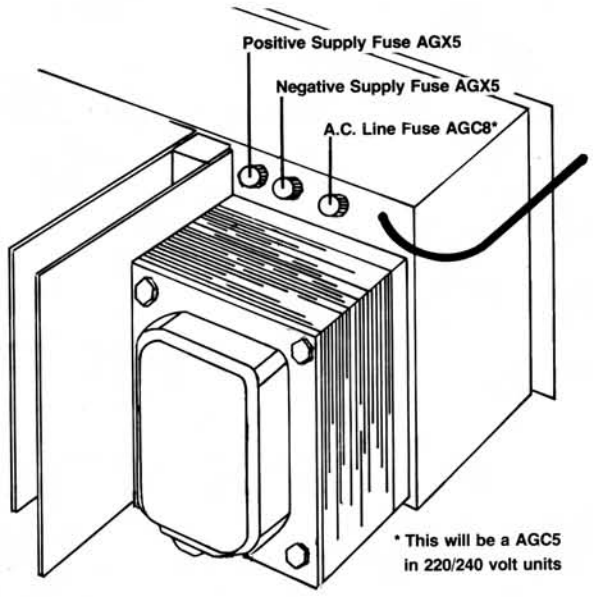
It is recommended that the switched A.C. input of the associated preamplifier be used to supply power to the Phase Linear.

AMPLIFIER FUSING

The amplifier is delivered from the factory with fuses appropriate for normal high fidelity use. The supply fuses are 5 AGX types. Should your amplifier start to distort or malfunction in any way, replace these fuses.

Since the peak-to-average voltage ratio of musical material is approximately 5:1 or greater, and since power is proportional to the square of the voltage, the peak to average power ratio is approximately 25:1 for most musical material. This means that when the amplifier is being driven to its limit of approximately 250 watts per channel, the average power delivered to the loudspeaker system is 1/5th of 250 watts or 50 watts. Since fuses respond to the average power level, full power operation of the amplifier with musical material is normally allowed using the factory installed 5 AGX fuses. Ordinarily they will open only on an accidental overload. For operations of the amplifier for other than high fidelity use at 8 ohms, 8 AGX fuses may be required. The common symptom of an open supply fuse is extremely high distortion and low power output. Continuous sine wave testing with both channels operating will require the use of the 8 AGX supply fuses. If it is ever desired to have the amplifier tested at one of the popular "amplifier clinics", it will be necessary to remove the factory installed 5 AGX fuses and temporarily install the 8 AGX fuses. It is not possible to complete the clinic tests with the 5 AGX supply fuses installed.

FIGURE 1



CONNECTION DIAGRAMS

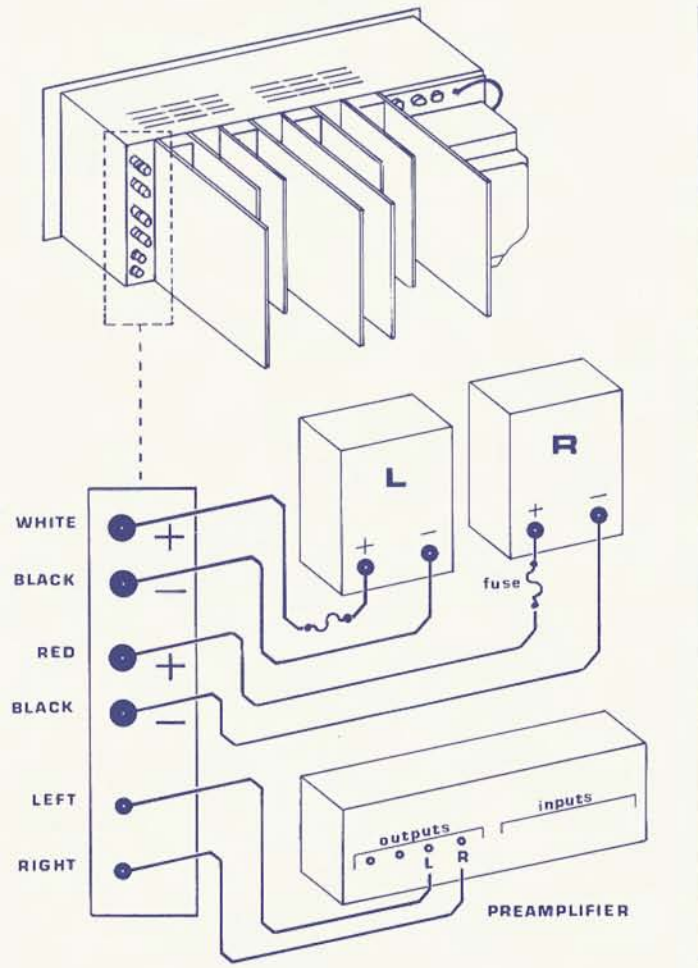


FIGURE 2

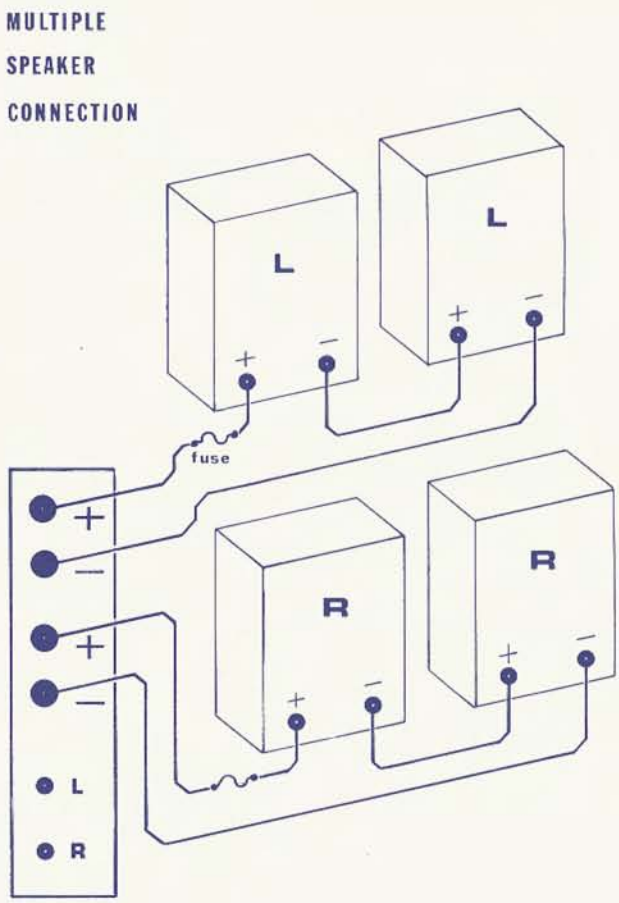


FIGURE 3

FUSING OF DOMESTIC AND EXPORT MODELS

The Phase Linear Model 400 is manufactured in both 120 volt and 220/240 volt models. The 120 volt model uses an 8 AGC A.C. supply fuse while the 220/240 volt model uses a 5 AGC supply fuse. Various changes have been made in all export models in order to comply with the regulations in the countries where they are to be sold.

THERMAL PROTECTION CIRCUIT

If your Phase Linear amplifier overheats it will automatically turn off. After a brief cooling period the unit will automatically turn on. If your amplifier does shut itself off check the impedance of the system you are driving to insure that it is not below 4 ohms. Should the Model 400 be used in an unusually high average power application it may be necessary for you to fan-cool the amplifier in order not to activate the thermal protection circuit.

CABINETS

A walnut cabinet is available for the Phase Linear 400 and can be obtained from your local dealer. Installation of a small whisper fan in the space provided on the cabinet back is recommended. A cooling fan compensates for the restricted air flow and can only prolong the life of electronic equipment. This fan is not necessary to produce the unit's rated power.

OPERATING INSTRUCTIONS

INITIAL USE

After connecting the Phase Linear 400 as shown in Figure 2, the following procedures should be followed when initially operating the unit:

1. Turn on the pre-amp keeping the volume control as low as possible. Double check all connections to insure proper contacts. The V.U. meters should illuminate on the amplifier.

2. Gradually turn up the volume until music is heard through the speakers. The V.U. meters will indicate the relative power output of the amplifier. Meter ballistics are such that a 0 V.U. deflection will be obtained when full power is demanded on an impulsive waveform. During sustained high level signals, for example, a pipe organ, "off scale" deflection will normally occur. Deflection is proportional to the average value of the output signal. Since the peak-to-average signal ratio of music material is normally at least 5:1, 0 V.U. deflection indicates 201 watts on musical material or 50 watts when observing a continuous sine wave signal.

OPERATING CHARACTERISTICS

Amplifier temperature:

Due to special high energy/high voltage technology, the transistors in the Phase Linear 400 can function properly at temperatures over 200 degrees centigrade. The Phase Linear output stage operates at temperatures less than half that value. The amplifier, however, will be hot to the touch when being run at maximum output and this is normal. No damage will be caused to the unit due to its high temperature during operations.

Turn off thump:

The Phase Linear 400 has a slight turn-off thump which will not damage any part of your system. It is normal and not to be considered a malfunction.

SPEAKER FUSING

Since you have now incorporated a high-powered amplifier into your system, it is important that you realize the necessity of proper inline speaker fusing for the full protection of your speaker system. Although the supply fuses contained in Phase Linear amplifiers provide a considerable measure of speaker protection the fuses are designed primarily to protect the amplifier. Because of the large variety of speakers available on the market today, Phase Linear recommends the use of additional in-line fuses for optimum speaker protection.

Determine from the speaker manufacturer the correct protection fuse for your specific model. Place a fuse socket in the speaker line where it will be easily accessible.

If fusing information is not available from the manufacturer or you have built your own speaker system, Phase Linear recommends the following procedure for determining the correct speaker protection fuse:

1. Obtain 2 each of 1 amp, 1.5 amp, 2 amp, etc. fast-acting fuses.
2. Insert the proper socket into the speaker line as shown in the diagram.
3. Place the smallest fuse into the socket.
4. Starting at low volume, play your system with suitable music material.
5. Slowly increase the volume while listening carefully for any distortion.
6. If the fuse opens before you have reached a substantial listening level, insert the next larger fuse into the socket. Repeat this procedure until you have reached a desirable listening level at which the fuse will not open.

The result of the above procedures will allow good performance from your system while protecting the speakers from large excursions such as dropping a tone arm, losing a ground, etc. Remember, fuses are much easier to replace than speaker components.

SOUND REINFORCEMENT AND INDUSTRIAL USE

When using the Phase Linear 400 in a sound reinforcement or industrial application, the following procedures should be followed.

1. The unit should be fan cooled.
2. The impedance of the speakers should be greater than 4 ohms and this should be checked with an ohmmeter.
3. When transporting the unit care should be taken not to damage the chassis.
4. Only the recommended fuses should be used.
5. The weight of the transformer makes additional support necessary if the unit is to be rack-mounted.

CIRCUIT DESCRIPTION

The Phase Linear amplifier consists of two direct coupled designed linear power amplifiers combined to form a single, dual channel unit capable of extremely high power output.

The output stages employ twelve high current, high voltage, triple-diffused silicon output transistors arranged in a quasi-complimentary format and biased for class AB operation.

The output stages are driven by two stages of Darlington connected current amplifiers, which in turn are driven by a predriver voltage amplifying stage swinging the full supply voltage.

The upper output transistors are driven into saturation by a constant current source and the lower transistors are driven by the predriver.

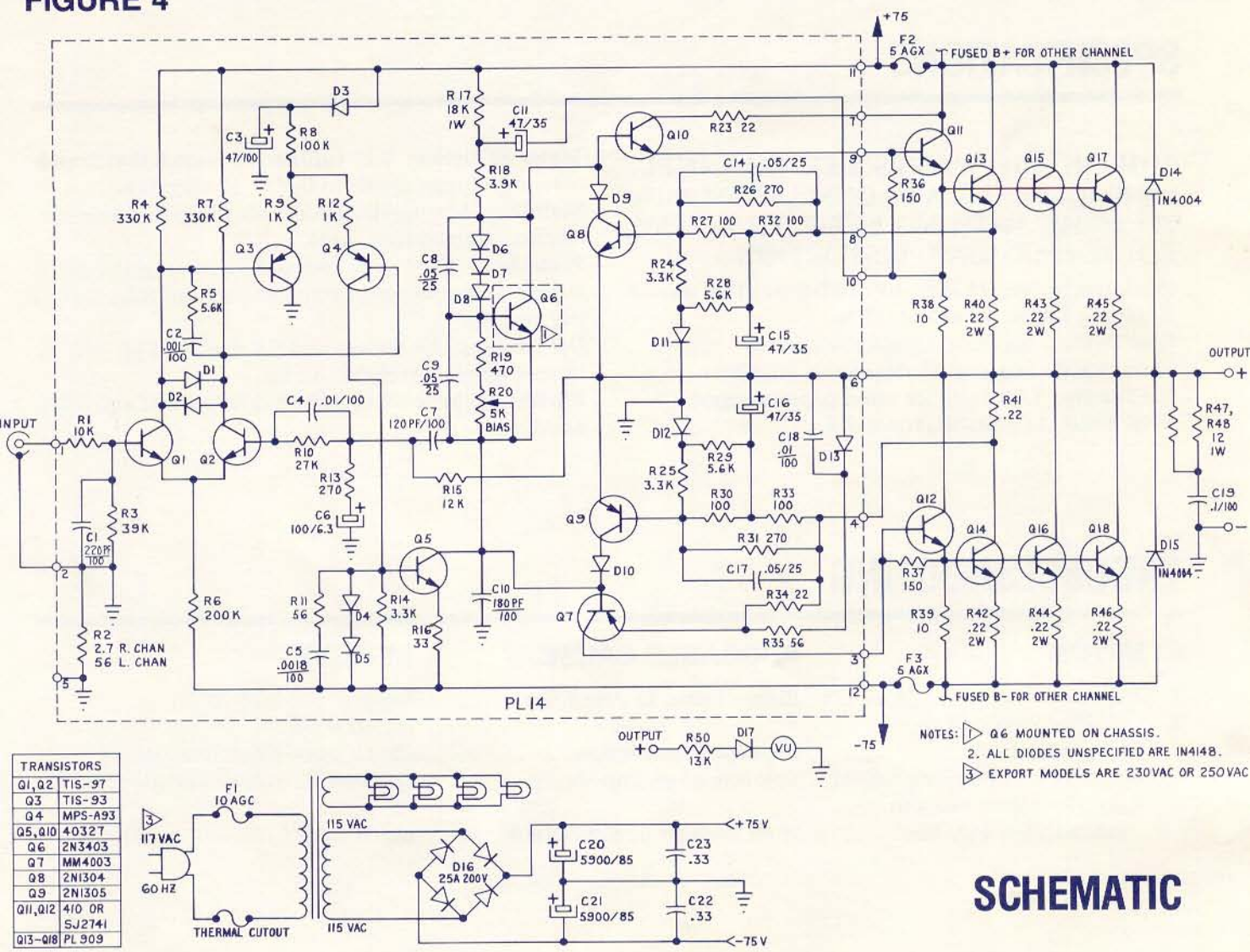
Bias control is accomplished by a bias regulator consisting of two voltage reference diodes, a regulator transistor, and temperature compensating circuitry.

The low level stage consists of a differential pair which provides voltage gain and level shifting to accommodate the predriver requirements.

The patented protective circuits consist of four small analog to digital computers, each computer monitoring the operating conditions of four output transistors. Output current, voltage, energy, time rate of current and voltage change, and common mode conduction are monitored continuously during amplifier operation.

If the value of any one, or the sum value of more than one or all of these quantities exceeds a safe stress level for the transistors, the computer instructs a "disconnect circuit" to instantly shut down the amplifier.

FIGURE 4



TRANSISTORS	
Q1, Q2	TIS-97
Q3	TIS-93
Q4	MPS-A93
Q5, Q10	40327
Q6	2N3403
Q7	MM4003
Q8	2N1304
Q9	2N1305
Q11, Q12	410 OR SJ2741
Q13-Q18	PL 909

SCHEMATIC

MAINTENANCE & SERVICING

CLEANING

To keep your amplifier clean and looking like new, occasionally clean the front panel with a soft paper towel and full strength ammonia. This will remove dulling films which have a tendency to build up on the brushed finish.

CAUTION: Never remove the front panel by turning the bolts on the face of your amplifier. This will scar the front panel. To remove the front panel loosen the nuts on the rear of the unit.

REPAIR FACILITIES

Only qualified technicians should be allowed to repair your Phase Linear 400. The Phase Linear Corporation and its authorized warranty stations have the personnel and equipment to repair your unit. Should you have any problems with your unit write to the factory for the address of the nearest repair facility.

Please include the model and serial number of the unit together with a description of the problem..

SHIPPING

Never ship your amplifier in any shipping carton other than the original or a replacement supplied by Phase Linear. For a free replacement write to the factory or see your local dealer. If the amplifier is shipped in other than a Phase Linear carton which is properly packed all damages must be paid for by the store or person shipping the unit.

Ship only via a reputable carrier. **DO NOT USE PARCEL POST!** Insure the unit for the full value and double check to ensure the unit is properly packaged.

SPECIFICATIONS

POWER: 201 WATTS PER CHANNEL, MINIMUM R.M.S. AT 8 OHMS FROM 20Hz TO 20kHz, WITH NO MORE THAN .25% TOTAL HARMONIC DISTORTION.

Hum and Noise: At least 100 dB below rated power.
Damping Ratio: 1000:1 at 20Hz.
Rise Time: Less than 1.7 microseconds.
Phase Shift: Lagging 12 degrees at 20kHz.
Sensitivity: 1.75 volts for rated power output.
Slew Rate: 11 volts/microsecond.
Meter Ballistics: V.U. calibration is such that impulsive waveforms result in 0 V.U. at clipping.
Stability: Absolutely stable with all loudspeakers including electrostatic units.
Protection: Electronic energy limiters together with supply fuses prevent excursions into unsafe operating regions.
Dimensions: 19 inches wide, 7 inches high and 10 inches deep. **Weight:** 35 lbs.
Finish: Light brushed gold, baked enamel and black anodize.

TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Distortion	Blown Fuses In Amplifier	Replace Fuses (5 AGX)
2. Amplifier Shuts off due to overheating	Improper Ventilation	Install a fan. Check impedance of speakers.
3. Snapping and Popping Sound	Too low of an impedance	Use correct output impedance
4. Amplifier blows fuses in industrial or P.A. use	High average power output	Use 8 AGX fuses and install fan

Printed In U.S.A. OM400-3