Phase Linear 700 Output Relay Installation Procedure

Before Beginning The installation is straightforward and easy if you follow the procedure. However allow yourself 4-5 hours and take the time to do a good quality job. You will be making connections to the bridge rectifier for AC power. A high power soldering iron is needed and it is easy to burn other wires nearby. When making connections, twist the wires after stripping the insulation so there will be no frayed ends. It is very important when making connections to the PCB that all wires are in the slot. The output connections leave little room for error.

Mods and Upgrades If you are going to do any mods or upgrades (cap replacements) wait until after the relay is installed and operational. If there are any problems this will make trouble shooting easier.

Box Contents
Relay Board
1 red binding post
1 white binding post
2 black binding posts
2 input jacks
1 ground clip
4 1/4" x 1.5" standoffs
4 4-40 screws
4 40 lock washers
1 28" white wire (may also be gray or green)
1 48" black wire (may also be blue or purple)
Tywraps

Tools Required
- 1/2" Nut Driver (input jacks)
- 7/16" Nut Driver (binding posts)
- 3/16" or 1/4" Nut Driver (binding posts) two different size nuts are available
- 1/8" Screwdriver (terminal strips)
- #1 Phillips screwdriver
- Fine sandpaper (to prep input jacks to solder)
- Soldering gun or high wattage iron, 60 watt or more (AC power connection)
- Solder
- Rosin flux (suggested, but not absolutely necessary)
- High quality wire strippers (Stripmster by Ideal. Avoid the bolt cutter/crimper/stripper combo)
- Wire cutters
- DVM (checking power supply voltages)
- Light bulb limiting power supply (See attached drawing, <$10 to build)
- Plastic bowl for hardware. Don't use a box. Parts get lost in the flaps.
- Piece of card board the size of the front panel (to protect it from scratches)
- Masking tape (to make labels)

Overview
In the following procedure you will remove the input RCA jacks and output binding posts and replace them with new ones. As part of the installation of the binding posts the grounding system is modified. Then the relay board is mounted to the new binding posts with standoffs. Once the board is mounted seven connections are made to the board. In addition to the four output wires, three wires provide power to the board from the bridge rectifier and ground on the capacitors.

Replacement of the input jacks is not mandatory. The input jacks are included because after 30 or so years of use they are likely to be intermittent. If so, now is a good time to replace them.

Procedure

1. ☐ See the pictures below or go to http://www.flickr.com/photos/watts_abundant/. You can also search for "Phase Linear relay" at Flickr.com.

2. ☐ Check the DC offset voltage for each channel. To do this disconnect the inputs and speakers. With the amp turned on measure the voltage on the output terminals. If it's more than 50mv (typical is less than 15), contact us at watts.abundant@yahoo.com.

3. ☐ Inspect the relay board for signs of shipping damage.

4. ☐ Clean off the bench and put away all the tools. Keep things neat and orderly.

5. ☐ Put all hardware that came with the kit in the container mentioned above.

6. ☐ Remove top and bottom covers. Put hardware in container.

7. ☐ Remove front cover. On series II amps remove the 6 screws that secure the sub panel. Put all hardware in the container.

8. ☐ Set amplifier on the bench so that it is resting on the heatsinks. The driver PCB inside the amp should be facing up. The front panel (series I) or sub panel (series II) should be folded back and resting against the heatsinks. Use the cardboard between the heat sink and panel to protect from scratches. During the installation you will need to rotate the amp around a few times so make sure to grasp the panel and the amp when doing so.

9. ☐ Inspect the amplifier driver board for any signs of heat damage.

10. ☐ Note the location of the bridge rectifier on the left near the capacitors and the output terminals on the right.

11. ☐ Replace the RCA input Jacks, **one at a time.** Unsolder or cut the input lead as close as possible to the right input jack. Leave the bare ground wire alone. Remove the jack and replace it with the new one. Make sure the fiber washers are in place. Reconnect the lead to the jack and solder it. **NOTE:** It may be necessary to burnish the jack and use paste flux to make a good solder connection.

    If you removed both jacks at the same time you didn't follow directions and now the fiber washers fall out, roll around on the floor and get lost. New ones are $5 each to help you remember to follow directions.

12. ☐ Replace the left channel input jack as in the previous step.

13. ☐ At the input jacks, cut the solid ground wire off about .25 inch from the binding posts.

14. ☐ Use masking tape to label the wires on the binding posts. The labels should note the color of the binding post, White, Black, Red etc. Cut each wire off as close as possible to its binding post. There is a small white wire that connects to the main driver board. Move it out of the way. It will be connected to the relay board during the last step.

15. ☐ Remove each binding post, one at a time and replace it. **The nuts are very easy to cross thread.** Use the 7/16" nut driver to start the nut. It should tighten all the way down with ease. If it becomes even slightly difficult to turn, stop at once as it is cross-threaded. Remove the post and carefully start the nut on the post to repair the threads. Then reinstall the post in the chassis. Use a 4 penny nail or large paper clip in the hole on the binding post to keep it from turning.

16. ☐ If there are 4-40 nuts on the binding post studs, remove them as they are not used.

17. ☐ A white wire will connect the bare input jack ground wire to the power supply ground on the relay board. Use a pocket knife to scrape away any oxidation on the last .25" of the bare ground wire on the input jacks. Tin the end of the bare wire.

18. ☐ Select the 28" white wire and cut a piece off about 4" long. Strip .25" insulation off of one end of the 4" wire. Tin the wire. Line it up to the bare wire. See below. Reheat the white wire and it should make a good connection to the bare ground wire. The other end of the white wire will eventually connect to the board.

19. ☐ Remove any debris such as bits of solder and pieces of wire.

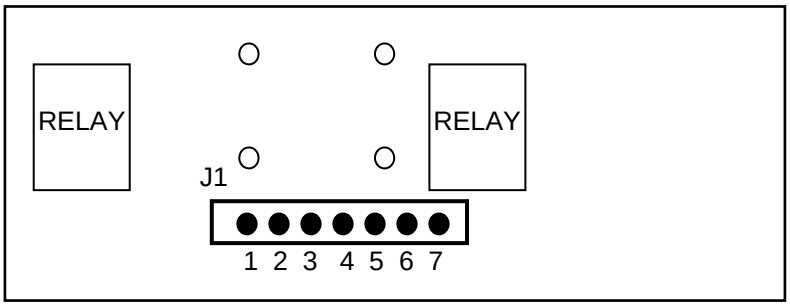
IN THE NEXT STEP DO NOT OVERTIGHTEN THE STANDOFFS OR THE STUDS WILL BREAK.

20. ☐ Rotate the amplifier so it is in the normal sitting position. Install a 1.5" /4-40 spacer on each binding post. Use the 4-40 screws and lock washer to loosely install the board on the spacers. Once all 4 screws are started then tighten them. The screw is tight when the lockwasher is compressed.

21. ☐ Look at the drawing below. The amplifier output wires and grounds are connected to the terminal strips next. Start by cutting the first two tywraps from the binding posts along the top of the chassis. Be careful not to nick the wires.

22. ☐ Start at connector J1-1. Strip no more than 1/4" of insulation off of the wire you labeled white. If it is stranded twist the wire so that it will not fray when you insert it in the terminal. Insert it at J1-1. Support the board with one hand while tightening the screw with the other. Do not over tighten. Dress the wire similar to how it was originally from the factory. Proceed with the other 3 connections as shown below on J1-2 through J1-4.

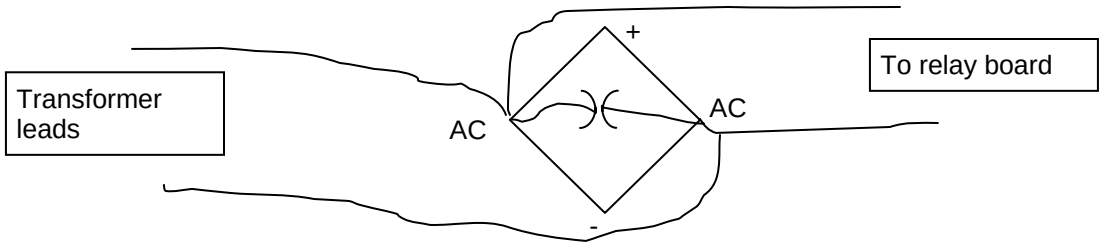
J1-1 Left channel output (white)
J1-2 Left Channel ground (black)
J1-3 Right channel output (red)
J1-4 Right channel ground (black)
J1-5 AC input to rectifier
J1-6 Ground
J1-7 AC input to rectifier



23. ☐ Inspect the connections above for frayed wires.

In the next few steps, a high wattage iron is mandatory to get a proper connection. Be careful not to burn any other wires nearby.

24. ☐ You will now install the AC wires to the bridge rectifier and then the ground wire. The wires will be routed horizontally along the bottom of the chassis. Assuming the supplied black wire is about 48" long, cut it in half. Locate the bridge rectifier that connects to the transformer leads. Solder one black wire to each of the the bridge rectifier terminals that are labeled AC. The other two terminals are + and – and connect to th large DC capacitors. There is usually a small capacitor soldered on to the AC terminals. This is not easy as it is difficult to get to the terminals without burning adjacent wires and your fingers.



25. ☐ Later you will terminate the other end of the AC wire to the relay board at terminal J1-5 and J1-7 .

26. ☐ In this step you install a ground lug to the copper bar that connects the two main capacitors together. Before removing the screw on the lower capacitor check to see if there is a lock washer between the copper bar and the capacitor. Remove the screw while keeping the lock washer in place. Install the ground lug on the screw and reattach the screw to the capacitor.

27. ☐ Take the remaining piece of white wire and solder it to the ground lug.

28. ☐ Route the black wires by the new white ground wire and towards bottom of the chassis. Twist or weave the three wires together the entire length of the wire. Leave adequate strain relief. You can always cut the wires shorter, but you can't stretch them longer.

29. ☐ The two black wires to the board at terminals 5 and 7 (AC)

30. ☐ You should now have 3 unattached white wires. There is a white wire that you connected to the bare ground wire at the input terminals. There is a white wire that connects to the driver board and the new white wire that came from the ground on the main capacitors.

31. ☐ The three white wires are now twisted together and inserted into terminal 6 on the relay board. **Make sure all strands are fully inserted or they will short to the AC wires on terminal 5 and 7.**

32. ☐ Recheck all connections. Double check for frayed wires at the relay board terminal block.

TESTING

Wear ANSI approved safety glasses when working with electricity.

Power Up Method With Light Bulb Test Set (Preferred)

1. ☐ There should be no input or output cables connected. The light bulb test set shown below is highly recommended for initial testing. In the event that a mistake is made it will prevent catastrophic failure. A variac doesn't limit current and does not provide adequate protection.

2. ☐ To use the test set plug the amp into the "Amp Under Test" socket. Do not connect any cables to the amplifier input/output jacks.

3. ☐ Verify the switch is in the center off position.

4. ☐ Plug a 100 watt bulb into the other socket.

5. ☐ Plug the test set into a standard 120V outlet.

6. ☐ Move the switch to the test position. The lamp should momentarily be very bright and begin to dim in less than 3 seconds. If it does not dim stop. Do not go any further until the problem is found.

7. ☐ If the bulb dims, move the test set switch to off and then to normal. The relay should click within 5 seconds. If it doesn't there is likely to be a wiring problem. See Troubleshooting below.

8. ☐ If a signal generator is available insert a 1KHZ sine wave into the left channel. Set the generator level to obtain 40 VAC on the amplifier output.

   NOTE: A computer sound card can act as a signal generator with widely available freeware.

9. ☐ Decrease the frequency until the relay clicks. This should be between 1.1Hz and 30 Hz.

10. ☐ Raise the frequency to above 100Hz. The relay will re-energize..

11. ☐ Repeat steps 8-10 for the right channel.

    NOTE: Testing with a continuous sine wave is quite different than playing music. The amp may seem to trip too early. If it trips off when playing music see the troubleshooting section.

Power Up Method Without Light Bulb Test Set

Warning. You've spent a lot of time and money to get his far. Take a little extra time and build the test set. If you're stubborn and refuse to use the light bulb test set, proceed below.

1. ☐ Slam on the amp by plugging it into an outlet strip fitted with a circuit breaker and hope for the best.

2. ☐ Go to step 8 above and continue.

TROUBLESHOOTING

The light bulb test set does not dim, fuses blow, smoke, something smells hot.

1. All boards assembled at the factory are tested before it shipped. What's different now?
2. Survey the damage. Recheck all connections

Relay energizes but no sound on one or both channels

1. Input connections reversed at terminals 1-4.
2. Loose mounting screws.
3. Remove mounting screws and check bottom of board for debris or shorts near the binding posts

Relay does not energize

1. If using the light bulb test set the bulb should be barely glowing. Otherwise there will not be enough voltage to the board. Check all connections going to the board. Verify your installation with the pictures at Flickr.com.
2. Check board for damaged/bent parts or bad solder joints.
3. Make the following voltage checks with respect to the power supply common (copper buss bar on the power supply caps).

J1-1	0VDC +/- 50mv
J1-2	0VDC, 0 ohms
J1-3	0VDC +/- 50mv
J1-4	0VDC, 0 ohms
J1-5	50-60 VAC
J1-6	0VDC, 0VAC, 0 ohms
J1-7	50-60 VAC

   Cathode of D1 (band) should be about 80-90 VDC.

Relay trips at high signal levels

1. If the signal source is a turntable, check for excessive rumble, record warp, or tonearm/cartridge problems.
2. High levels at sub bass frequencies may appear to the relay circuit as a high DC voltage. Please contact the factory for additional assistance.

Relay takes several seconds to drop out when power is turned off

1. The wire that connects to the bridge rectifier is on the DC terminal instead of the AC.

THEORY OF OPERATION

The two channels are summed together through R1 and R6. A few seconds after power up, C2 charges enough to allow Q2 to turn on which then drives Q3 to turn on. When power is turned off the relay quickly de-energizes as C3 is intentionally small. High level bass signals below 5Hz or DC will quickly release the relay.

LIGHTBULB TEST SET

Notes:

1. Use a duplex outlet and mount everything in a 4* square box.
2. The switch is available at Home Depot and Radio Shack.
3. Cut the female end off of a computer power cable for the power cord.
4. The light bulb plugs into the socket using an adapter you get at the hardware store.
5. You have to break the link between the two silver screws to properly connect everything.
6. Referring to the diagram below, the silver screws are on the longer slot on the outlet.
7. When bringing up an amp start in the test mode. The bulb will be very bright at turn on and then it should dim. If it stays bright there is a fault/short circuit. Do not switch to Normal position until you find the fault.
8. For preamps and signal processors use a 25 watt bulb.
9. **Most important. Anyone who uses this is responsible. I'm not.**